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The Practical Teacher

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CONTENTS.

	PAGE
Arithmetic Prize Papers. By W. P. Workman, M.A., B.Sc.	619
Conversational Lessons in Chemistry. By Thomas Cartwright, B.A., B.Sc. (Lond.)	621
Mental Arithmetic for the Standards. By T. B. Ellery, F.R.G.S.	622
New Problems in Arithmetic. By T. B. Ellery, F.R.G.S.	624
Pupil Teachers' and Scholarship Course. By Arthur T. Flux	626
Facts and Notions. By Richard Waddington	632
Jolly Good Fellows. A Play for Boys. By Joseph Despicht	634
New Composition Stories.—Standard V. ...	638
New Reading Tests.—Standard III.	639
New Dictation Tests.—Standard IV. ...	640
Well-known Teachers at Work. XLI.—Mr. George Sharples. With Portrait ...	643
Teachers' Drawing Lessons. By E. Buffery Ridge	647
Music—'Old England, we Love Thee' ...	649
Circular to H.M. Inspectors	650
Coming Men. XV.—Mr. Harry Weston ...	650
Our 1895 Certificate Class. By J. C. Horobin, M.A.	652
Examinations in Government and Citizenship	658
Query Column	658
Reviews	660
Mathematics. By G. A. Baxandall	663
Organic Chemistry Notes. By J. T. Hewitt, M.A., D.Sc., Ph.D.	665
Science Notes	668
Chemistry Notes. By W. Tate, A.R.C.S., F.C.S.	669
Notes on Theoretical Mechanics. By F. Castle, M.I.M.E.	670
Honours Physiography Notes. By A. M. Davies, B.Sc. (Lond.), F.G.S.	670

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Wisdom is humble that he knows no more.'—COWPER.

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ARITHMETIC PRIZE PAPERS.

BY W. P. WORKMAN, M.A., B.SC.,

Head Master of Kingswood School; late Fellow of Trinity College, Cambridge.

PAPER No. IV.—SOLUTIONS.

1. The number whose reciprocal is ·00016126..... is $\frac{1}{\cdot00016126}$ = 6201·1658..... But we are told that the decimal is the reciprocal of an integer. Therefore this integer is 6201.

But $6201 = 9 \times 13 \times 53$.

Now $\frac{1}{53} = \cdot018,867,924,528,\frac{1}{3}$.

$\therefore \frac{1}{9 \times 53} = \cdot002,096,436,058,\frac{7}{9}$.

$\therefore \frac{1}{9 \times 13 \times 53} = \cdot000,161,264,312,2.....$

The next five figures are therefore 43122. Ans.

2. The given expression is

$$\{6201^{-1} - 6202^{-1}\}^2 - \{6203^{-1} - 6204^{-1}\}^2$$

$$= \frac{1}{6201^2.6202^2} - \frac{1}{6203^2.6204^2}.$$

Various devices might be suggested at this point for saving a little labour, but it is questionable whether they are worth the trouble involved. The expression may be treated thus, straightforwardly—

$$= \frac{6203^2.6204^2 - 6201^2.6202^2}{6201^2.6202^2.6203^2.6204^2}$$

$$= \frac{[6203.6204 - 6201.6202][6203.6204 + 6201.6202]}{6201^2.6202^2.6203^2.6204^2}$$

$$= \frac{24810 \times 76942014}{6201^2 \times 6202^2 \times 6203^2 \times 6204^2}$$

$$= \frac{19089 \times 10^8}{6201^2 \times 6202^2 \times 6203^2 \times 6204^2},$$

retaining only five significant figures in the numerator. The remaining divisions are perhaps most quickly effected separately using contracted methods. The stages, with a possible error in the last figure, are :—

$$= \frac{30784 \times 10^4}{6201 \times 6202^2 \times 6203^2 \times 6204^2} = \frac{49644}{6202^2 \times 6203^2 \times 6204^2}$$

$$= \frac{80045 \times 10^{-4}}{6202 \times 6203^2 \times 6204^2} = \frac{12906 \times 10^{-7}}{6203^2 \times 6204^2} = \frac{20806 \times 10^{-11}}{6203 \times 6204^2}$$

$$= \frac{33542 \times 10^{-15}}{6204^2} = \frac{54065 \times 10^{-19}}{6204} = 87145 \times 10^{-23}$$

$$= \cdot000,000,000,000,000,000,871,45.$$

If the result be calculated by seven-figure logarithms, it is—

·000,000,000,000,000,000,871,477,6.

In this result, owing to the logarithms being given only to seven figures, there is a possible error of 2 in the sixth figure, and the seventh figure is quite uncertain.

3. $S = 1 + \frac{1}{2} + \frac{1}{3} + ... + \frac{1}{18}$

$$= (1 + \tfrac{1}{18}) + (\tfrac{1}{2} + \tfrac{1}{17}) + (\tfrac{1}{3} + \tfrac{1}{16}) + ... + (\tfrac{1}{9} + \tfrac{1}{10})$$

$$= \frac{19}{1.18} + \frac{19}{2.17} + \frac{19}{3.16} + ... + \frac{19}{9.10};$$

$$\therefore \frac{S}{19} = \frac{1}{1.18} + \frac{1}{2.17} + ... + \frac{1}{9.10}$$

$$= \begin{array}{l} \frac{1}{18} + 1 - 1 \\ + \frac{1}{18} + \frac{1}{2} - \frac{1}{2} \\ + \frac{1}{48} + \frac{1}{3} - \frac{1}{3} \\ + \frac{1}{80} - \frac{1}{4} + \frac{1}{4} \\ + \frac{1}{70} + \frac{1}{5} - \frac{1}{5} \\ + \frac{1}{72} - \frac{1}{6} + \frac{1}{6} \\ + \frac{1}{81} - \frac{1}{7} + \frac{1}{7} \\ + \frac{1}{88} - \frac{1}{8} + \frac{1}{8} \\ + \frac{1}{90} + \frac{1}{9} - \frac{1}{9}. \end{array}$$

Of these fractions the first pair in each line is to be taken together, and the fractions at the end of each line added together. The result is—

$$\frac{S}{19} = \frac{19}{18} + \frac{19}{68} + \frac{19}{144} - \frac{19}{60} + \frac{38}{210} - \frac{38}{78} - \frac{19}{168} - \frac{19}{264} + \frac{19}{360} - \frac{72 + 18 + 8 - 24 + 12 - 36 - 9 - 6 + 3}{72}$$

$$= \frac{19}{18} + \frac{19}{68} + \frac{19}{144} - \frac{19}{60} + \frac{38}{210} - \frac{38}{78} - \frac{19}{168} - \frac{19}{264} + \frac{19}{360} - \frac{38}{72},$$

and is divisible by 19.

$\therefore S$ is divisible by 19^2.

The theorem is a particular case of a theorem given by Mr. G. Osborn in the *Messenger of Mathematics*, vol. xxii., p. 51. The general theorem is that if p is a prime number greater than 3, and not otherwise, the numerator of

$$\frac{1}{1} + \frac{1}{2} + \frac{1}{3} + ... + \frac{1}{p-1}$$

is divisible by p^2.

4. (1) Ans. 6·175.

(2) Ans. ·00027.

(3) Ans. $\frac{501,613,765,452,723,020,380,888,740,394,253}{257,601,069}$

$$= \frac{22}{73} + \frac{821}{4100} = \frac{150133}{299300}.$$

5. (1) Ans. 92,578,402,060.

(2) 'Casting out elevens' in scale 12 is performed by simply adding the digits, just as 'casting out nines' in scale 10.

An error will be detected if the sum of the figures in which the error is made is not divisible by 11. But if the error be a perfectly random error, there are for every ten numbers not divisible by 11 one which is so divisible; ∴ the chances are 10 to 1 that an error will be detected, and the probability that an error will remain undetected is $\frac{1}{11}$.

(3) The G.C.M. should be thus arranged :—

3	8641ℓ / 11111	1
	7295ℓ | 8641ℓ	
1	1357ℓ | 24690	1
	11111 | 1357ℓ	
	2469 | 11111	5
		11111
		.....

Ans. 2469.

(4) The fractions are readily simplified, without passing out of scale 12, by use of the rule of G.C.M. Ans. $2\frac{1}{2}$.

(5) (*a*) $\frac{11}{160}$ is not in its lowest terms, but reduces to $\frac{55}{90}$. Now the factors of 90 are $2^2 \times 3^2$. These are all factors of 12, ∴ the fraction gives a non-recurring duodecimal. Moreover, 12^2 is the lowest power of 12 into which $2^2 \times 3^2$ divides; ∴ the duodecimal has 3 figures.

(*b*) $\frac{ee}{6\alpha 4}$ is in its lowest terms. The factors of $6\alpha 4$ are $2^3 \times 5^3$. Now since 5 is a prime number prime to 12, $\frac{1}{5}$ gives rise to a circulating duodecimal with either 4, 2, or 1 figures in its period. As a matter of fact it has 4 figures, but this cannot be told from inspection.

∴ $\frac{1}{5^3}$ will give rise to a circulating duodecimal with either 1, 2, 4, 5, 10, 20, 25, 50, or 100 (scale 10) figures.

∴ $\frac{ee}{6\alpha 4}$ will give rise to a mixed circulating duodecimal with three non-recurring figures, followed by a recurring period containing either 1, 2, 4, 5, 10, 20, 25, 50, or 100 figures. This is all the information obtainable by inspection.

The general law upon which this result depends is not very widely known. It is stated in Sonnenschein and Nesbitt's Arithmetic, which contains the most scientific treatment of this subject known to me, but it is not, I think, in any other English book. It is as follows :—

If p be a prime number with a period of n figures, then
p^2 will have a period of either n or np figures,
p^3 " " " n, np, or np^2 figures,
p^4 " " " n, np, np^2, or np^3 figures, etc.

(*c*) $\frac{AA}{\alpha\alpha 1}$ is obviously in its lowest terms. But $441 = 5^4$. Hence by the last result $\frac{AA}{\alpha\alpha 1}$ gives rise to a pure circulator with either 1, 2, 4, 5, 10, 20, 25, 50, 100, 125, 250, or 500 (scale 10) figures.

(*d*) $\frac{1}{41}$ is in its lowest terms. But $41 = 7^2$. Now 7 is a prime prime to 12; ∴ it has either 1, 2, 3, or 6 places in its period [6 is the correct number].

∴ $\frac{1}{41}$ has either 1, 2, 3, 6, 7, 14, 21, or 42 figures.

(*e*) $\frac{1}{8} = \frac{1}{2^3} = \frac{6^3}{10^3}$ (scale 12), and is clearly non-recurring with 3 figures.

(*f*) $\frac{1}{10}$ is non-recurring with 1 figure.

(*g*) $\frac{\ell}{e}$ is a pure circulator with either 1, 2, 5, or 10 (scale 10) figures. [It has actually 1.]

6. (1) Is incorrect. The correct enunciation is — 'The chances that a random undecimal fraction is a pure circulator are exactly 10 to 1.'

For there are in scale 11 ten numbers prime to 11 for every number not prime to eleven.

(2) The given numbers suggest the factors of 347953968. The number is $2^4 \times 3^4 \times 383 \times 701$.

Now by data 383 is divisible into the number formed by 382 nines, and 701 into the number formed by 700 nines.

∴ 383×701 is divisible into the number formed by (L.C.M. of 382 and 700) nines; *i.e.*, into the number formed by 133700 nines.

Now 3^2 is divisible into 9.

∴ 3^4 is divisible into the number formed by 9 nines.

But 133700 is not divisible by 9; ∴ we must take $9 \times 133700 = 1203300$ nines to obtain a number divisible both by 3^4 and by 383×701.

∴ $\frac{1}{3^4 \times 383 \times 701}$ gives a pure circulator of 1,203,300 figures.

∴ $\frac{5^4}{3^4 \times 383 \times 701}$ gives a pure circulator of 1,203,300 figures.

∴ $\frac{5^4}{10^4 \times 3^4 \times 383 \times 701}$ gives a mixed circulator with 4 zeros and then a circulating period of 1,203,300 figures.

∴ $\frac{1}{2^4 \times 3^4 \times 383 \times 701}$ gives a mixed circulator with 4 zeros and then a circulating period of 1,203,300 figures.

∴ $\frac{1}{347,953,968}$ gives a mixed circulator with 4 zeros and then a circulating period of 1,203,300 figures; *i.e.*, the recurrence commences at the $(1,203,300 + 4 + 1)^{\text{th}}$ figure; *i.e.*, the 1,203,305th figure.

7. (1) If the number is divisible by 131, then, since 131 is not an exact fifth power, the fifth root must also be so divisible. Hence the completed number is divisible. Now the remainders on dividing by 131 are as follows :—

123756,	92	;	1000000,	77
1023756,	122	;	100000,	47
1203756,	128	;	10000,	44
1230756,	11	;	1000,	83
1237056,	23	;	100,	100
1237506,	80	;	10,	10
1237560,	3	;	1,	1

We have to choose such a multiple of the number in the fourth column as added to the corresponding number in the second column may produce a multiple of 131.

Form a table of the various multiples of the fourth column with the second column numbers added :—

1	2	3	4	5	6	7	8	9
169	246	323	400	477	554	631	708	785
169	216	263	310	357	404	451	498	545
172	216	260	304	348	392	436	480	524
94	177	260	343	426	509	592	675	758
123	223	323	423	523	623	723	823	923
90	100	110	120	130	140	150	160	170

The multiples of 131 are—

131 262 393 524 655 786 917 1048 1179.

The only one of these which occurs in the table is 524. Hence the missing figure is 9, coming in the third place, counting from the left, and the number is 1293756.

(2) $$\left\{10^{15} + 1\right\}^{\frac{1}{3}} = 10^5 \left\{1 + \frac{1}{10^{15}}\right\}^{\frac{1}{3}}$$
$$= 10^5 \left\{1 + \frac{1}{3} \cdot \frac{1}{10^{15}} - \ldots\ldots\right\}$$
$$= 10^5 + \frac{1}{3} \cdot \frac{1}{10^{10}} - \ldots\ldots\ldots$$
$$= 100000{\cdot}00000000003\ldots\ldots,$$

and therefore differs in the eleventh place.

(3) If the cube of 19·993331 be found by contracted methods, correct to 5 significant figures, it will be clear that the integer of which it is the cube root is 7992.

Now $\sqrt[3]{7992} = 2\sqrt[3]{999} = 2(1000 - 1)^{\frac{1}{3}}$

$$= 20\left(1 - \frac{1}{1000}\right)^{\frac{1}{3}}$$
$$= 20\left[1 - \frac{1}{3} \cdot \frac{1}{1000} - \frac{1}{9} \cdot \frac{1}{1000^2} - \frac{5}{81} \cdot \frac{1}{1000^3} - \frac{10}{243} \cdot \frac{1}{1000^4}\right.$$
$$\left. - \frac{22}{729} \cdot \frac{1}{1000^5} - \frac{154}{6561} \cdot \frac{1}{1000^6} - \ldots\ldots\right].$$

$\frac{1}{3} \cdot \frac{1}{1000} = \cdot 000,333,333,333,333,333,333,333,\ldots\ldots$

$\frac{1}{9} \cdot \frac{1}{1000^2} = \cdot 000,000,111,111,111,111,111,\ldots\ldots$

$\frac{5}{81} \cdot \frac{1}{1000^3} = \cdot 000,000,000,061,728,395,061,\ldots\ldots$

$\frac{10}{243} \cdot \frac{1}{1000^4} = \cdot 000,000,000,000,041,152,263,\ldots\ldots$

$\frac{22}{729} \cdot \frac{1}{1000^5} = \cdot 000,000,000,000,000,030,178,\ldots\ldots$

$\frac{154}{6561} \cdot \frac{1}{1000^6} = \cdot 000,000,000,000,000,000,023,\ldots\ldots$

$\cdot 000,333,444,506,214,021,969,$
$\cdot 999,666,555,493,785,978,031$
20

Ans. $19\cdot 993,331,109,875,719,560,62.$

The eighteen decimal places underlined are probably correct.

If the use of the Binomial Theorem for fractional indices to such an extent as the above be objected to (and it is certainly open to question beyond the first few terms, as lying outside the domain of Arithmetic), six of the additional eight figures can be readily obtained by the rule for contracting cube root. We have only to evaluate, correct to 6 significant figures.

$$\frac{7992 - (19\cdot 993331)^3}{3(19\cdot 993331)^2}.$$

This will give us the next 6 figures, *i.e.*, 109,875.

Then $$\frac{7992 - (19\cdot 993,331,109,875)^3}{3(19\cdot 993,331,109,875)^2}$$

will give us 12 more figures, and we should then have the cube root correct to 28 significant figures.

The work is not so long as might appear, if only contracted methods be used.

8. A can win 50 points while B wins 35.
" " 50 " " C wins 30.
$\therefore$ B " 35 " " " "
$\therefore$ B " 70 " " " 60.
$\therefore$ B can give C 10 points in 70. *Ans.*

9. The sum of the 10 results is 10·6092.
" " first 6 " 6·258,
$\therefore$ " " last 4 " 4·3512.
But " " last 5 " 5·3612,
$\therefore$ the sixth result is 1·01,
$\therefore$ the seventh " 1·0201.
But the sum of the last 4 is 4·3512,
$\therefore$ " " " 3 is 3·3311,
$\therefore$ the mean " " 1·11036.....

10. Suppose that A has £270. £90 of this is invested and $\therefore$ £100 of stock acquired, and £2½ received annually as interest on this stock, *i.e.*, in the eight years, £8 × 2½ = £20 is so received. The stock is now sold at £80, and $\therefore$ in the eight years £80 + £20, *i.e.*, £100 is received as principal and interest.

The remaining £180 is lent to B, and $\frac{£36}{5}$ is received annually for interest for four years, *i.e.*, $£\frac{144}{5}$ altogether. In the next four years $£\frac{144}{5}$ becomes added to the debt, which now becomes $£180 + £\frac{144}{5} = £208\frac{4}{5}$. On this B pays 13s. 4d. in the £, $\therefore$ A receives $£\frac{2}{3} \times 208\frac{4}{5} = £139\frac{1}{5}$. Hence A has received altogether,

$$£100 + £28\tfrac{4}{5} + £139\tfrac{1}{5} = £268,$$

i.e., £2 less than he started with.

But we are told that he actually receives £10 less than he started with, $\therefore$ he started with £5 × 270 = £1350.

11. February 29th fell on a Monday in 1808, 1836, 1864, 1892, 1904.

Problems of this character can be constructed *ad infinitum* by aid of Lucas' 'Perpetual Calendar.' See 'Récréations Mathématiques,' T. iv.

MENTAL ARITHMETIC.

There is but little in this paper calling for note. Several candidates obtained more than 90% of the maximum.

2, 3. Those who know the Binomial Theorem and Newton's Rule for forming the coefficients can use their knowledge here.

$(x+1)^2 = x^2 + 2x + 1$; $\therefore 11^2 = 121$.
$(x+1)^3 = x^3 + 3x^2 + 3x + 1$; $\therefore 11^3 = 1331$.
$(x+1)^6 = x^6 + 6x^5 + 15x^4 + 20x^3 + 15x^2 + 6x + 1$.

Thus the mental operation for 121^3 or 1331^2, which are, of course, the same, is

16
15
20
15
6
1

1771561. Ans.

10. 701 is a prime.

11. L.C.M. should be done mentally by successive steps.
Thus L.C.M. of 32 and 33 is 32 × 33.
35 has no factor common to this; $\therefore$ L.C.M. now is 32 × 33 × 35.
36 requires one more 3, etc.

12 and corresponding questions are easier than would be thought.

17. (2), (3), (4), (5). Factors are available only for 17 (2).

17. (3) $= (1000+1)^3 - (1000-1)^3$
$= 2[3.1000^2 + 1]$
$= 2[3000001]$
$= 6,000,002.$ Ans.

Similar methods are easy for the rest.

CONVERSATIONAL LESSONS IN CHEMISTRY.

BY THOMAS CARTWRIGHT, B.A., B.SC. (LOND.),
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For particulars of the List of Chemicals and PRACTICAL TEACHER Set of Apparatus for working the experiments referred to in these lessons see numbers for January and February 1893.

LESSON XXII.—SILVER.

WHAT do I hold in my hand, Tom? A silver shilling, sir. But is it silver pure and simple? Oh no, sir; I remember that all our coins are alloys, and that copper is mixed with silver in order to make the coin harder and better able to withstand wear and tear. Quite true, and it would be a very easy matter to show the presence of copper in our shilling, but at present we are concerned with silver. I think I have already told you that by far the greater number of useful ores are compounds of oxygen, sulphur, or carbonic acid. This, certainly, is the case with silver, and perhaps you can tell me in which of the three states silver is found in nature. I see you are eager to answer, Minnie, so let us hear what you have to say. When we went over the ores containing sulphur, sir, you showed us a specimen of silver ore which you called silver glance, because it was shiny, so that silver will be found in combination with sulphur. Very good, and what will you call a compound of silver and sulphur? Silver sulphide, sir. Well, it now remains for me to show you three or four different specimens of silver ore in order to finish this first part of our lesson. This is the simplest, as it contains only the two elements in question, whereas this one contains antimony in addition to silver and sulphur. Whilst this third specimen contains arsenic, and, finally, here is an ore consisting of copper, silver, and sulphur. It will be easy for you to remember that the commonest ores of silver are the sulphides, and that we have (1) *silver sulphide*, (2) *silver-antimony-sulphide*, (3) *silver-arsenic-sulphide*, and (4) *silver-copper-sulphide*, all of which are valuable ores.

What is your question, Annie? Did you not tell us, sir, when dealing with lead, that lead ores always contained some silver? Yes, and it is quite true; such ores indeed are called argentiferous lead (L. *argentum*=silver, *fero*, I bear), and it is separated from this lead ore by a process called *cupellation*, about which we shall speak anon. Most of you know from your geography lessons that silver is found pretty extensively, especially in Spain, Mexico, Nevada, and California. Although it is sometimes found native, most frequently it occurs in one of the forms described above, viz., as sulphide. The reduction of the ores depends upon their richness. The rich ores of America are separated by amalgamation with mercury, the best method to employ being as follows:—The ore is finely crushed and then placed in revolving pans provided with machinery capable of converting the substance into an exceedingly fine powder. Mercury is now added, and the whole contents of the pans are thoroughly mixed, with the result that part of the mercury combines with the sulphur, according to the following equation—

$$Ag_2S + Hg = HgS + 2\,Ag.$$

The excess of mercury dissolves the silver, and after separating the amalgam from the sulphide the silver can be set free by heat, which causes the mercury to sublime, as we saw in our preceding lesson.

The separation of silver from lead is equally interesting. When the molten mixture of lead and silver has been obtained, a blast of air is blown upon the mixture, which lies on a moveable hollow oval dish made of porous bone-ash, called a *cupel*.

What will now happen, Lilla? The oxygen of the air will combine with the lead and silver. That would hardly suit our purpose, which is to separate the two metals. Well, Bob, what do you say? The oxygen will combine with the lead, sir, and not with the silver, because silver is not acted upon by air. Yes, and now you see how the separation proceeds. The oxide of lead is litharge, a specimen of which is before you on the table. As soon as formed it melts, and some of it sinks into the pores of the cupel, some runs over the sides, so that the layer of lead oxide gets thinner, until at last a bright bead of silver appears at the bottom of the cupel.

Here is a solution of common salt (NaCl), and another of silver nitrate ($AgNO_3$). Let Minnie add one solution to the other. What do you think the white curdy substance is? Is it silver chloride, sir? Yes, the two bodies break up and then recombine to form two pairs of new compounds.

This mode of chemical action represents both *analysis* and *synthesis*, and is called *double decomposition*.

$$NaCl + AgNO_3 = AgCl + NaNO_3.$$

Watch the white silver chloride. What colour is it now? It is of a slate colour, sir. Yes, and by-and-by it will become darker, until quite violet. What do you think is the cause of this change, Maud? Think of the formation of HCl when H and Cl are brought together. Ah, I see Bob has the answer to this seeming puzzle, so we will call upon him. It is the light, sir, that has worked the change. Of course it is, and you ought to have remembered that *heat*, *light*, and *electricity* are the commonest and most potent agents in bringing about chemical changes. What is the change, sir? I cannot say; but it will suffice for our purpose if you recollect that light darkens certain compounds of silver, especially the chloride (AgCl), the bromide (AgBr), and the iodine (AgI). Everybody can now tell me what art depends upon this property. I thought so. Well, Minnie? Photography, sir. Yes, when the cap is removed from the camera the light from the object to be photographed falls upon a glass plate covered over with a solution containing silver bromide, which is acted upon by the light in the manner above shown. Over this, in the dark room, is placed a coating of a substance which will counteract the action of light on the unaltered silver salt. Under this is now placed another plate covered with more silver solution, and the light passed through the altered plate alters this second plate in exactly the same way. This of course is *printing*, or the multiplication of photographs, the first process being the method of obtaining a *negative*, from which copies may be procured in the way thus indicated. Salts of silver, therefore, are the prime essential in photographic processes.

This same nitrate of silver is used by the surgeon for 'burning the throat,' etc., in order to get rid of excrescences. It is called lunar caustic, a name which takes us back to the old fanciful nomenclature of the alchemists, who bestowed the name *luna*, 'moon,' on the pale metal silver, caustic coming from the Greek καυω, I burn, which indicates the use to which the body is put.

Silver nitrate is also used (when mixed with gum) as *marking ink*, for marking clothes, whilst another use to which the body is put is that of a *hair-dye*.

For what other purpose is silver used, Trixie? Is it not used in plating vessels? Yes, and it will not be difficult to understand this if you go back to the electrolysis of water. You will remember that when that body was decomposed by the electric current the H collected at one pole, the O at another. In the same way, when a silver salt is decomposed by electricity, the silver collects at one pole, the other element or elements at the other; therefore if the vessel to be coated be connected with the silver-receiving pole it will be plated by the action of the electric current.

Let us now sum up the results of this somewhat prolonged lesson.

We have learnt—

(1) That silver occurs free, but is mostly found as sulphide;
(2) That it is separated by (*a*) amalgamation, (*b*) by cupellation;
(3) That silver salts are decomposed and made black by light;
(4) That upon this depends (*a*) photography, (*b*) the manufacture of marking-ink, (*c*) and of a hair-dye;
(5) That silver coins consist of silver and copper (Ag, 95%; Cu, 5%).

MENTAL ARITHMETIC FOR THE STANDARDS.

BY T. B. ELLERY, F.R.G.S.,
President of the National Union of Teachers.

'Mental work will strengthen the power of computation, and facilitate the handling of simple problems.'—MR. CODD, H.M.I.S.

INFANTS AND STANDARD I.

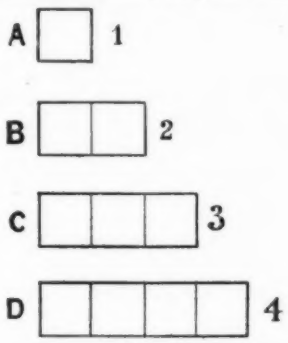
THERE is probably no better training for children than mental arithmetic. Good daily practice on proper lines will sharpen the wits, teach the children to think for themselves, ensure accuracy, and prepare the way for intelligent solution of problems. The most successful teachers of arithmetic are those who make this mental practice their first consideration.

H.M. Inspectors report that there is improvement in the arithmetic results in schools generally; the reason is that *mental* practice is now compulsory in every standard, and even the most mechanical teacher has found how much his labours are lightened, and how much more pleasant the work has become, since he began to devote some portion of every arithmetic lesson to this very necessary and extremely valuable aid. Even now, however, young teachers are frequently left too much to themselves and to their 'methods,' with the result that all the good possible is not being done.

With these young people there is no system; the time is, therefore, not spent to the best advantage. With some it is too much trouble to place on the table in front of the class, where all can see, cubes, marbles, balls, pencils, &c., &c.

It never occurs to them that they should hasten slowly, that with the younger children, who are just beginning their studies, the best possible practice is operations with numbers up to, say, 10 or 12, and that any 'drill' beyond this is out of place at first.

To these young people let me say, use the blackboard, and show by simple diagrams how (for example) the numbers 6, 8, 10, 12 are made up of parts. Use the ball-frame, too, and use it freely.



Let your pupils see that B is *twice* A, that C is *three times* A, and D *twice* B and *four times* A, and so on. Deal with 6, 8, 10 in the same way. Let the same practice be given with cubes, marbles, balls, &c., &c. Then go on to show that A is one-half of B, the fourth part ($\frac{1}{4}$) of D, the third part ($\frac{1}{3}$) of C, and that B is one-half of D. Let the children add the *cubes*. Thus A and B together make 3, B and C 5, C and D 7, A and C 4, B and D 6, and so on. Do not attempt to hurry. This *number building* is of first importance, and in making this groundwork sure you are doing the very best for your children and for yourselves.

I do not think I could do better than give you an extract from Dr. Fitch's report on American Schools:

'In most of the schemes of instruction the arithmetical course is laid out in a careful and logical order, the method of Grube being very generally adopted. The characteristic feature of this method is that it does not regard addition, subtraction, multiplication, and division as four processes graduated in difficulty and to be learned in succession; but it assumes that the true progression is from small numbers to large. Hence the beginner takes, for example, the number 12. He is made to see and to count cubes, balls, or other objects. He adds, subtracts, multiplies, and divides all the numbers up to 12. He is shown or helped to find out in how many ways that number is made up of parts. He learns all its fractions and aliquot parts; he applies the number to hours, to money, and to inches, and whatever arithmetical process is possible within that narrow limit he learns to perform. After that he proceeds in the next class, say, as far as the number 50, and will take up the arithmetic of one dollar, not going beyond the limit, but performing every operation within it. Big numbers and elaborate notation are reserved till later. It is believed that by knowing all the properties of small and manageable numbers, and by varying the exercises upon them, the scholar obtains a far better mastery over figures, and a truer preparation for dealing with more complex magnitudes, than if he works in succession a number of sums in groups, each group illustrating a single rule. The method seems to me a good and rational one, and I was much pleased with the results. It is certainly more interesting to the children. The helpless way in which scholars at home sometimes ask when a question is given, "What rule is it in?" is a sure proof that they have been unintelligently taught. Much use is made of mental arithmetic in all the schools, and the manuals suggest some ingenious devices for varying the form of the questions. Here, for example, is a little artifice which I found in very effective use in some of the lower classes. The nine digits are written on the board in a circle, and in any irregular order. The teacher takes a pointer and begins, for example, with an outside number—4. He points in rapid succession to each of the numbers, requiring the pupils to say as he goes round from the figure 3 to the right, 4, 7, 12, 20, 27, 31, 37, 39, 40, 49. He then begins again from the top, or from any one number in the circle, and moves round to the left. By trying at different points, starting with different numbers from without, he may get an endless variety of combinations, and make the addition of any one number to another unit very familiar. And whenever he sees that there is a hitch or pause in proceeding from one number to another, he notes that particular combination as one in which mistakes are more likely to occur, and gives a number of special exercises upon it.'

9
1 3
2 5
6 8
4 7

In the 'Instructions to Inspectors, 1895,' there is evidence of a desire to see in every school some application of the method of Grube, to which Dr. Fitch refers. Read paragraph 26.

'Mental Arithmetic is a class exercise, and may often be satisfactorily tested by requiring the teacher of the class to give a few questions in your presence, and by adding at discretion some questions of your own.

'The object of this exercise is to encourage dexterity, quickness, and accuracy in dealing with figures, and to anticipate, by means of rapid and varied oral practice with small numbers, the longer problems which have afterwards to be worked out in writing. It is obvious that this general object cannot be attained if the exercises are confined to a few rules for computing "dozens" and "scores," such as are often supposed to be specially suited for mental calculation. A footnote to Schedule I. calls your attention to the importance of rapid addition.

'Occasionally a long column of figures may be written in the sight of the scholars, and they may be required to name in quick succession the results of each addition as the inspector or teacher points to the several figures in any order. Oral practice should be given in all the ordinary processes of arithmetic, and should be so varied as to furnish as many different forms of exercise as possible in concrete as well as abstract numbers, and in the fractional parts of money, weights, and measures. In the last quarter of the school year it should deal chiefly with the work of the next highest standard. It is often found to be a help in calculation if the dimensions of the schoolroom, the playground, and the desks, and the weight of a few familiar objects are accurately known, and if the figures recording the particulars are easily accessible, and are occasionally referred to as standards of measurement.'

Many methods may be employed to make the lessons interesting. Call the children one by one to the table, and let each perform some simple operation, such as adding 3 marbles and 2 marbles; taking 6 marbles, and seeing how many remain after giving the teacher 2; giving 2 marbles to each of 3 boys, then 4 boys, and then 5 boys, and seeing how many have been given away altogether; taking 8 marbles, and seeing how many boys can receive 2 each from that number, and so on. The practice can be varied to almost any extent. Then the class may repeat, after each operation, the result of that operation; thus the sum of 2 and 3 is 5; 2 from 5 leaves 3; 3 from 5 leaves 2. When some headway has been made, it is a good plan to arrange 'a match' between the boys. Choose 'sides,' and let the boys on one 'side' put questions to boys on the other. Let marks be given as the game proceeds, and at the close let these be added. The 'side' scoring the greater number of marks wins the game. In the hands of a skilful, patient teacher, even games like these can be turned to good account.

Introduce *money* as soon as possible. Show the children the actual coins. Let them come to the table and handle them, and perform simple opera-

tions with them. They will soon know that there are 2 farthings in a halfpenny, 4 in a penny, 8 in 2 pence; 2 halfpennies in a penny, 4 in 2 pence; 6 pennies in a sixpenny piece, 3 in a threepenny piece, 12 in a shilling; 2 sixpences in a shilling, 4 in a florin, 5 in half a crown (two shillings and sixpence), and so on. Let the children learn the names of the coins. They will soon be able to perform simple operations in reduction. Thus: How many pennies would you give me for this sixpenny piece? How many would you give me for this shilling? How many threepenny pieces would you give me for this sixpenny piece? For this shilling? How many halfpenny buns could I buy with these two pennies? three pennies? three pennies and a halfpenny? How many slates at two pence each could I buy with this sixpenny piece? with this shilling? I have in my hand a threepenny piece, a penny, and a halfpenny. How many halfpenny balls could I buy with the money? I give a halfpenny to each of 6 boys; which of the silver coins on the table will allow me to do this exactly? I give to one boy 2 halfpennies, to another 2 pennies, and to another a threepenny piece. What do I give away in all? A boy saved a halfpenny a day for 10 days. What did he save in that time? To how many boys can I give threepence each out of sixpence? out of a shilling?

I have a shilling; how much remains after I have given five boys twopence each? How many shillings are there in this crown? in this half-sovereign? To how many men can I give a florin each out of half a sovereign?

You will see that in all this I have not gone beyond the number 12. Do not forget to drive home the lesson of each operation. Thus, the sum of 3 and 4 is 7, 3 from 7 leaves 4, 4 from 7 leaves 3. The sum of 7 and 3 is 10, the sum of 3 and 7 is 10; 3 from 10 leaves 7, 7 from 10 leaves 3.

This repetition is necessary, and there must be much of it. The difference between this repetition, however, and that in which no coins, marbles, cubes, etc., are employed is this: you have made the lesson interesting, you have shown the children the results by actual experiments; and this makes all the difference in the world in teaching!

The following may now be given, but of course it must be understood that the exercises are but suggestions. The teacher must make each the basis of a good lesson and give other examples similar in form.

1. Add 1, 2, and 3.
2. Take 2 from 5; 3 from 6; 2 from 8.
3. I had 8 apples; I gave away 5; how many left?
4. I had 9 nuts; I gave 2 to Harry and 3 to Fred; how many left?
5. How many have I more than Fred? more than Harry?
6. We have 9 nuts in all; if each eat two, how many are left?
7. I have 7 apples and John has 3. If I give him one, how many have I now more than he?
8. John gives away two of his apples and I eat one of mine; how many have we together now?
9. I buy a dozen apples at a halfpenny each. How much do I spend?
10. How many halfpennies in sixpence? three penny pieces?
11. Tom has a shilling; he spends twopence, then threepence, and then fourpence. How much left?
12. How many halfpennies in the sum he has left? How many farthings?
13. If I give a halfpenny to each of 8 boys, how much do I give away? How much is this less than sixpence?
14. I have a shilling; if I give 4 boys a penny each and 2 boys fourpence each, how much is left?
15. A boy bought 3 apples, then 2, and then 6. He gave away 4. How many left?
16. A farmer bought a dozen sheep. He sold three of them, and afterwards five more; another died. How many left?
17. How many would the farmer have if he bought half a dozen more?
18. How many legs in all have 2 cows and a hen?
19. I gave 3 pennies to each of 3 boys and had twopence left. What had I at first?
20. If out of a shilling I spend fivepence, and then give threepence to one boy and a penny to another, what sum remains?

(*To be continued.*)

NEW PROBLEMS IN ARITHMETIC.

(SECOND SERIES.)

BY T. B. ELLERY, F.R.G.S.,
President of the National Union of Teachers.

2ND PAPER.

STANDARD IV.

THE first series having been well received, and the Editor's wish being law, the present series is submitted in the hope that teachers—especially the young and inexperienced—may derive some assistance in their heavy labours.

As I have said before, a number of the exercises may be found beyond some of the children in the Standard, but each will form the basis of a good lesson, and the whole set, carefully worked on the blackboard and by the children, will give excellent practice and help considerably in the preparation for the work of the next higher Standard.

For introduction see *The Practical Teacher* for October 1894, and for further particulars *The Girls' Mistress* for September 1st, in which issue appeared the first of a series of papers entitled *Standard Problems for Girls, and How to Solve them.*

The second series began with a set of tests for Standard III.

A.

1. I use $\frac{1}{2}$ oz. of sugar in every cup of coffee. If I drink 4 cups in a day, how long will a chest containing 6 lb. 8 oz. last?

2. The sum of £46 8s. $1\frac{1}{2}$d. was divided equally among 16 men, 18 women, 9 girls, and 12 boys. How much did each receive?

3. If half a pint of gooseberries cost a penny, what would you pay at this rate for $3\frac{3}{4}$ bushels?

4. If I had the eighth part of a shilling more I could buy 13 books at half a crown each, and $1\frac{1}{2}$ dozen at 9d. each. How much have I?

5. If I pay three and a half guineas for eighteen articles, what shall I pay for $2\frac{1}{4}$ dozen?

6. A man drinks half a bottle of wine a day. How many gallons will he drink in a year of 366 days, it being reckoned that 6 bottles make a gallon?

7. A woman has £3 15s. in her pocket. She spends £1 5s. in groceries and buys 4 pairs of boots at half a guinea a pair, and with the rest of her money she buys eggs at 14 for a shilling. How many eggs does she buy?

8. A man earns as much as 2 women and one boy. The boy earns 1s. 3d. a day, and each woman twice that sum. What does the man earn in a week of 6 days?

9. I gave $1\frac{1}{2}$ cwt. of rice in exchange for $10\frac{1}{2}$ lb. of tea at 2s. 8d. a pound. What was the cost of the rice per lb.?

10. A newsagent buys papers at the rate of 13 to the dozen, and buys 16 dozen at $9\frac{1}{2}$d. per dozen. He sells the papers one by one at a penny each. Find his gain.

11. A man bought a gross of pens for one shilling and four pence. How many dozen could he buy with £1 5s. 4d.?

12. A grocer paid £28 for 3 cwt. 3 qr. of butter. The butter was put up in seven-pound jars. Find the cost of one jar.

B.

13. A man has to put coal into a cellar, and he is paid $\frac{1}{4}$d. for every barrow-load. The cellar holds 15 tons, and a barrow-load is $2\frac{1}{2}$ cwt. What does he receive?

14. A grocer bought a cask of sugar weighing a ton for £14. After deducting 36 lb. for the cask and 8 lb. for waste, he sold the rest at $3\frac{1}{2}$d. per lb. What did he gain?

15. A farmer sold 12 cows at £18 10s. each, and 16 pigs at three pounds fifteen shillings each. He then bought nine horses, and had one hundred and twenty-four pounds ten shillings left. What did he pay for each horse?

16. I mix twelve pounds of tea at two shillings per pound with eight pounds at half a crown per pound and four pounds at three shillings per pound. Find the price of the mixture per pound.

17. A tradesman bought 180 yards of carpet at 2s. 4d. a yard. Owing to an accident one yard out of every ten was afterwards soiled and could not be sold. The rest he sold at 3s. 6d. a yard. How many guineas did he gain?

18. I buy 600 apples at 3 a penny, and sell them at two pence a pound, four apples weighing a pound. Find my gain.

19. I have in a bag sixteen guineas made up of a number of crowns, half-crowns, florins, and shillings. How many coins in all?

20. A lady bought 15 yards of dress material at 1s. $9\frac{1}{2}$d. a yard, $3\frac{1}{2}$ yards of silk at 4s. 11d. a yard, and buttons, ribbons, etc., came to 4s. 8d. The dressmaker took $2\frac{1}{2}$ days to make the dress, and charged three shillings a day for her work. What was the total cost of the dress?

21. If I walk seventeen hundred and sixty yards in $15\frac{1}{2}$ minutes, how many yards at this rate can I walk in 3 hr. 52 min. 30 sec.?

22. A man takes eighty steps every minute, each step twenty-four inches long. How many yards will he walk in two hours fifteen minutes?

23. A man's income is a halfpenny every minute of the day and night. Find his income from Monday at 9.15 a.m. to the following Friday at 2.10 p.m.

24. A square field, whose side is six hundred and sixty yards, has hurdles round it, the length of each being $4\frac{1}{2}$ feet. How many hurdles are there?

C.

25. A man bought a piano for forty guineas. He paid first £10 and then £5, and the remainder was paid in monthly instalments of £1 2s. 6d. How many monthly instalments were necessary to complete the payment?

26. I bought three cheeses, one weighing 2 qr. 10 lb., the second one-half that weight, and the third weighing as much as the other two together. Find the cost of the whole at $8\frac{1}{2}$d. per lb.

27. A grocer buys 3 cwt. sugar at $1\frac{1}{2}$d. a lb., and $2\frac{3}{4}$ cwt. at 2d. per lb. He sells the whole in 4 lb. packets at 9d. a packet. Find his gain.

28. A milkman sells milk at 6d. a quart, and receives daily £2 10s. How many gallons does he sell altogether in May and June?

29. I have in a bag 160 crowns, 120 half-crowns, 80 florins, and 60 shillings. I divide this among 16 men and 24 women, giving each man £2 10s. What does each woman receive?

30. A draper bought 8 packages of cloth, each containing $5\frac{1}{2}$ dozen yards, at the rate of 4 yards for half a sovereign. He sold one-half of the whole at 3s. a yard, and the rest at 3s. 6d. a yard. Find his gain.

31. How many pairs of boots at 90s. per dozen pairs could I buy with the money received from the sale of $2\frac{1}{2}$ dozen fowls at 3s. 9d. each?

32. Sixteen yards of silk and 18 yards of carpet cost £6 15s. The carpet was bought at the rate of three yards for half a guinea. What did I pay at this rate for 4 yards of silk?

33. I bought 560 lb. of tea at £11 4s. per cwt., and sold one-half at the rate of 7 lb. for a guinea, and the rest at the rate of 7 lb. for 18s. 1d. Find my gain.

34. There were 60 passengers in the 1st class carriages of a train, 90 in the 2nd class, and a certain number in the 3rd class. The 1st class fare was 8s., the 2nd class 6s., and the 3rd class 4s. 6d. The total receipts from all the passengers amounted to £87. How many passengers were in the train altogether?

35. 6 horses are worth 42 sheep, and 14 sheep cost £35. Find the cost of 18 horses.

36. A man can walk 264 feet in a minute. How many yards can he walk at this rate between 8.15 a.m. and 4.30 p.m., allowing that he rests from noon until 1 p.m.?

37. A man earns as much as 3 women, and 2 women earn as much as 4 boys. A boy earns 10d.

a day. What will 2 men, 2 women, and 2 boys earn in a week of 6 days?

38. Divide £11 5s. among A, B, and C, giving B £1 5s. more than C, and A £1 5s. more than B.

39. I bought a flock of sheep at £2 each. Six of these I sold at £2 10s. each, and the remainder at £2 15s. each, making a profit on the whole of £34 10s. How many sheep in the flock?

40. A farmer bought a certain number of sheep at £3 each. He sold ten at £3 10s. each, 20 at £4 each, and the rest at £4 10s. each, making in all a profit of £70. How many sheep did he buy?

ANSWERS.

(1) 52 days.
(2) 16s. 10½d.
(3) £2.
(4) £2 5s. 10½d.
(5) £5 10s. 3d.
(6) 30½ gallons.
(7) 112 eggs.
(8) £1 17s. 6d.
(9) 2d.
(10) 4s. 8d.
(11) 228 dozen.
(12) 9s. 4d.
(13) 7s. 6d.
(14) £18 0s. 6d.
(15) £17 10s.
(16) 2s. 4d.
(17) 7 guineas.
(18) 8s. 4d.
(19) 128 coins.
(20) £2 16s. 3d.
(21) 26,400 yards.
(22) 7,200 yards.
(23) £12 12s. 3½d.
(24) 1,760 hurdles.
(25) 24 instalments.
(26) £7 0s. 3d.
(27) £1 7s. 5d.
(28) 1,525 gallons.
(29) £1 1s. 8d.
(30) £19 16s.
(31) 15 pairs.
(32) 18s.
(33) £22 3s. 4d.
(34) 310 passengers.
(35) £315.
(36) 38,280 yards.
(37) £4 10s.
(38) A £5; B £3 15s.; C £2 10s.
(39) 48 sheep.
(40) 60 sheep.

NOTE.—This set should also be worked by the children in Standard V. as it gives good preliminary practice for the work of that Standard.

OUR PUPIL TEACHERS' AND SCHOLARSHIP COURSE.

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PUPIL TEACHERS' COURSE.

SCHEME OF WORK FOR THE MONTH.

A.—*English.*

First Year.

1. *The Preposition:*—Beach, 84–89; Daniel, 117–120. Be particular to learn some good classification.

2. Learn the Latin noun suffixes, meanings, and examples, and not only the *meaning* but the *use* in forming nouns from adjectives, nouns from verbs, etc.

3. Learn 50 Latin roots and meanings, with examples from Daniel or Beach.

4. Learn notes below on Gray's 'Bard,' and be prepared to analyse any lines or parse any words as far as line 75.

Second Year.

1. Prepare the syntax of the Adjective and Pronoun (Beach, 104–109; Daniel, 175–189). Note the Adjectives which can only be used predicatively, *e.g.*, ware, aware, afraid, alone, etc. Distinguish *the other* and *another*, *each* and *every*, *some* and *several*, etc.

2. Learn or revise the Greek prefixes.

3. Learn 50 Latin roots and meanings, with examples (Daniel, Beach, or any good list).

4. Goldsmith's 'Traveller.' Prepare for analysis lines 1–144. Learn the meaning of all allusions. Understand the meaning clearly and be prepared to parse any word.

Third Year.

1. Learn brief lives of the following authors and a list of their chief works:—Chapman, Udall, Wyatt, Sackville, Peele, Beaumont and Fletcher, Greene, Massinger, Ford, Ben Jonson, Marlowe, and Shakespeare.

2. Revise syntax and grammar of the Verb.

3. Learn 50 Latin roots and meanings (Daniel, Beach, or any good list).

4. 'Essay on Man.' Prepare up to line 112, taking care to understand the meaning and follow the argument. The paraphrasing, analysis, and parsing should be carefully considered, and any difficulties sent for solution. It would be very advisable to paraphrase the whole poem, taking from 25 to 30 lines per week.

B.—*Arithmetic.*

First Year.

Boys.—1. Learn proofs of the rules for converting Recurring Decimals to Vulgar Fractions.

2. Work:—Lock, Examples LXIV.–LXXIII. (selecting a few problems from each); Barnard Smith, Examples 29–31; Dixon and Beach, Examples 19 and 20.

Girls.—1. Dixon and Beach, Example IX.; Lock, Example LXXIX*b*.

Second Year.

Boys.—1. Read up 'Theory of Percentages.'

2. Work:—Lock, CXVI. and CXVII.; Barnard Smith, Examples LXV. and LXVI.; Dixon and Beach, Example XXXIII.

Girls.—1. Study carefully Dixon and Beach, Ch. XXV.

2. Work:—Example XXV., or similar examples in 'A & B' sums in any other text book.

N.B.—The arrangement of these sums is of great importance. Pupil Teachers should carefully study the following *Model Solutions:*—

(1) A can do a piece of work in 4 hours, B in 6, and C in 8. How long would it take them working together?

A can do the work in 4 hours, ∴ A can do $\frac{1}{4}$ per hour;
B ,, ,, 6 ,, ∴ B ,, $\frac{1}{6}$,,
C ,, ,, 8 ,, ∴ C ,, $\frac{1}{8}$,,

∴ A + B + C can do $\frac{1}{4}+\frac{1}{6}+\frac{1}{8}$ in an hour

$$= \frac{6+4+3}{24} = \frac{13}{24}.$$

Then 1. Time to do $\frac{13}{24} = 1$ hour.
2. ,, ,, $\frac{1}{24} = \frac{1}{13}$,,
3. ,, ,, $\frac{11}{24} = \frac{11}{13}$,,
$= 1\frac{11}{13}$ hours. Ans.

(2) A and B working together can do a piece of work in 6 days, B and C in 8, and A and C in 10 days. How long would it take each separately?

A & B can do the work in 6 days, ∴ A & B do $\frac{1}{6}$ in 1 day;
B & C ,, ,, 8 ,, ∴ B & C do $\frac{1}{8}$,,
A & C ,, ,, 10 ,, ∴ A & C do $\frac{1}{10}$,,

Then adding,

2A + 2B + 2C can do $\frac{1}{6}+\frac{1}{8}+\frac{1}{10}$ in 1 day $= \frac{47}{120}$;
or, A + B + C can do $\frac{47}{240}$ in 1 day.

Now, A + B ,, $\frac{1}{6}$,,
subtracting, C ,, $\frac{47}{240} - \frac{1}{8} = \frac{7}{240}$ in 1 day.

Therefore time it would take C to do the whole

$$= \frac{240}{7} = 34\frac{2}{7} \text{ days.}$$

Similarly, by subtracting B + C from A + B + C we get A's daily work, and subtracting A + C from A + B + C we get B's daily work.

(3) A cistern is filled by a tap A in 20 minutes, by another tap B in 30 minutes, and is emptied by another tap C in 40 minutes. All three taps are turned on (the cistern being empty), in what time will it be filled?

A fills it in 20 minutes, ∴ A fills $\frac{1}{20}$ in 1 minute;
B ,, 30 ,, ∴ B ,, $\frac{1}{30}$,,
C empties it in 40 ,, ∴ C empties $\frac{1}{40}$ in 1 minute.

Then the remainder left at the end of 1 minute will be

$$\frac{1}{20}+\frac{1}{30}-\frac{1}{40} = \frac{13}{120}.$$

Then, 1. Time to fill $\frac{13}{120} = 1$ minute;
2. ,, $\frac{1}{120} = \frac{1}{13}$,,
3. ,, $\frac{120}{120} = \frac{120}{7}$,,
$= 17\frac{1}{7}$ minutes.

If any difficulty is found with these sums write for solution.

Third Year.

Boys.—The extraction of the Square Root and Cube Root, and problems arising therefrom. Barnard Smith, Examples LXVIII. and LXX.; Lock, Examples CXXXVII.–CXLII.; Dixon and Beach, Examples XXXIX. and onwards.

Girls.—Work as many problems as possible on the application of Square Measure to painting, papering, and carpeting surfaces.

C.—*Music.*

First Year.—The Standard Scale of Pitch. Mental Effects and their modification.

Selected questions :—

1. What is a Major Scale? How does it differ from the Minor?

2. What are the three chief chords of the Major Scale? In what order should they be taught, and why?

3. What are the mental effects of *ray, fah, te, lah, me?*

4. Which note of the scale is most calm, which is most sad, which is most firm, and which is rousing?

5. What are the leaning tones of the scale? Why are they called leaning tones? Which tones lean most?

6. Give four ways in which the mental effects of tones may be modified, with an example in each ease.

7. Name the following intervals :—

d—l, m—t, f—m', r—f, s—d', r—t, f—l, m—d', s—r', t_1—l, m—d', f—s, r—l, d—t, f—r', s—m', m—r', f—t, d—m', r—f.

8. Between which notes of the scale are there (*a*) minor seconds, (*b*) pluperfect fourths, (*c*) perfect fifths?

Second Year.—Continue practice in transition. Six and nine pulse measures and accents.

Selected questions :—

1. Re-write the following passage, making a change to the first flat key at (*a*), and a return to the original key at (*b*):—

(*a*) (*b*)
m f r d s ta m f l r f d' t d' r d

2. Re-write the following passage in the perfect method:—

l ta s f d' ta s m d' r' ta l s m f

3. Re-write (*a*) in the 'better' method, (*b*) in the imperfect method:—

(*a*) **l fe r s fe d' t l s fe m fe s**

(*b*) **d m r 'd m f t_1 r 'm l t d'.**

4. If the first note of each of the following passages is regarded as *me*, what will the others become?

(*a*) **t r fe s l fe l t m fe s**

(*b*) **l f ta s d' l ta r d ta_1 l_1.**

5. State exactly what the singer is told to do at $^dg_1$, in the following passage :—

s l r m $^dg_1$ l_1 t_1 r d.

Third Year.—Names of chromatic notes and the principles on which they are named.

Selected questions on the Minor Scale :—

1. Write an ascending minor scale (lah mode), using the minor 6th and major 7th, and a descending scale using the minor 6th and minor 7th.

2. Name the following relations of the minor or lah mode:—(*a*) Dominant, (*b*) minor or essential 6th, (*c*) leading note or essential 7th, (*d*) super tonic.

3. State clearly the difference in intervals and mental effect between a major scale (Key D) and a minor scale (Key F, lah is D) having minor 6th and major 7th.

4. Which tetrachord of the minor scale (lah mode) never varies? Write the variable tetrachord in three forms, and state which of these is exactly like the corresponding tetrachord of the major scale.

5. Write a diminished 7th above *se, me', fe* and below *doh* and *soh*.

6. Name the following intervals :—*Doh—se, se—doh', fah—se, se—fah, se—ray, la—se, la—doh, doh—se, se—me', te—se.*

7. Give an example of (*a*) an augmented 5th, (*b*) an augmented 2nd, (*c*) an augmented 4th, (*d*) a diminished 5th, (*e*) a perfect 5th from the following scale :—

l_1 t_1 d r m f se l.

D.—*Spelling.*

Learn 50 words each week from 'Words Commonly Mis-spelt,' or any good list. Test by dictation.

E.—*Geography.*

Australia.—Political and industrial geography of the various colonies.

New South Wales.

(*a*) Industries.

1. Agriculture—Wheat, maize, oats, barley, potatoes, sugar cane, tobacco, grapes, and oranges.
2. Dairy farming.
3. Pastoral (56 million sheep, half a million horses).
4. Mining—Coal, gold, silver (note Broken Hill District).
5. Manufactures.

(*b*) Towns (position and importance of)—Sydney, Newcastle, Bathurst, Broken Hill, Bourke, Albany, Parramatta, and Goulbourn.

(*c*) History—

1788. First settlement at Sydney, a convict station.
1824. First Legislative Council appointed.
1843. First Popular Assembly.
1851. Transportation of convicts stopped. Discovery of gold.
1856. Complete Home Rule.

Victoria.

(*a*) Industries as above. Gold, £230,000,000 since 1851.

(*b*) Towns — Melbourne, Ballarat, Bendigo, Geelong, Echuca.

(*c*) History—

1834. First settlement.
1850. Made an independent colony.

South Australia.

(*a*) Industries.

1. Agriculture—Wheat, oranges, raisins, wine.
2. Pastoral—Sheep, cattle, camels, ostrich farms.
3. Mining—Copper, iron, silver.

(*b*) Towns—Adelaide, Port Adelaide, Wallaroo, Gawler, Kapunda, Kooringa, and Palmerston.

(*c*) History—

1836. First settlement.
1856. Responsible government granted.
1864. Extension of Boundary to the North Coast.

Queensland.

(*a*) Industries.

1. Pastoral—21 million sheep, 7 million cattle, 50,000 horses.
2. Agriculture—Maize, sugar cane, rice, bananas, pine-apples, oranges.
3. Mining—Rich in minerals.
4. Fishing—Pearl in Torres Strait, and Bêche-de-Mer on Barrier Reef.

(*b*) Towns—Brisbane, Maryborough, Rockhampton, Gympie, Ipswich, Townsville.

(*c*) History—

1842. First settlement.
1854. Separated from New South Wales and made a colony.

West Australia.

(*a*) Industries.

1. Pastoral—2½ million sheep, 150,000 cattle, 50,000 horses.
2. Agriculture—Oranges, apricots, figs, bananas.
3. Mining—Gold, copper, tin, lead, coal. (Note gold fields in Kimberley and Coolgardie Districts.)

(*b*) Towns—Perth, Freemantle, York, Albany, and Geraldton.

(*c*) History—

1829. First settlement.
1890. Responsible government granted.

Tasmania.

(*a*) Industries.

1. Agriculture—All European fruits and vegetables.
2. Mining—Tin, gold, coal, silver, lead, slate, and stone.

(*b*) Towns—Hobart, Launceston, Beaconsfield, and Waratah.

(*c*) History—

1803. First settlement (convict).

1825. Separated from New South Wales, made an independent colony.

1850. Responsible government granted.

Draw maps; insert all places, etc., to be remembered.

Memory maps.—The memory maps for pupil teachers and scholarship students are presented as a supplement to this month's issue. They must be constantly practised.

F.—*History.*—*All Years.*

The whole course having now been covered, the next four months will be devoted to revision. Special attention must be paid to the points indicated each month; selected Government Questions will also be given to assist and direct the reading. Dates, genealogical tables, plans of battles, etc., must be carefully and finally prepared.

Revise History from 55 B.C. to 827 A.D.

Chief points:—Earliest notices of Britain—Cæsar's invasions—His account of the Britons: manner, mode of warfare, religion, etc.—The Roman settlement; the chief governors and their policy; the results of Roman occupation—The reason for abandonment of Britain by the Romans—The Saxons: who they were, and whence they came—The foundation of the kingdoms—The introduction of Christianity—The struggle for supremacy among the kingdoms.

Learn carefully the meanings of all terms of this period, such as:—Druid, vate, bard, proprætor, prefect, count of the Saxon shore, the classes of Roman towns:—Colonia, Municipia, etc.; Witanagemote, Bretwalda, etc.

Typical questions on this period:—

1. Give some account of the earliest mention of Britain.

2. Describe the religion of the ancient Britons.

3. What led the Romans to invade Britain? Give particulars of Cæsar's invasion.

4. Write short accounts of Caractacus, Cassivelaunus, Boadicea, Suetonius Paulinus, Julius Agricola, Carausius.

5. 'The true conqueror of Britain was Julius Agricola.' Explain this statement, and point out the limits of his power in Britain.

6. Mention *three* great Roman generals who visited England before A.D. 60, and give a short account of one of them.

7. Name some of the great Roman roads which were constructed, and explain their purpose.

8. The towns of the Romans in Britain were divided into four classes. Distinguish these, and give examples of each class.

9. Give as many as you can of the results of the Roman occupation. What remains still exist?

10. What parts of the country were settled by the Angles, Jutes, and Saxons, respectively? What do you know of the original homes and subsequent settlements of these people?

11. Describe the territories which formed the kingdoms of Wessex and Mercia.

12. What do you know of the introduction of Christianity into the country (*a*) by Augustine; (*b*) by the Irish missionaries?

13. Who were the Bretwaldas? Which of them were most distinguished? Write a life of one of them.

14. 'The Saxon kingdoms ultimately became three, and these three finally one.' Explain this statement fully, giving names and dates.

15. Assign events to the following dates:—B.C. 55, A.D. 61, 78, 121, 410, 597, 800.

16. Who was King Arthur?

17. Draw a map of Britain, inserting (*a*) the Roman walls; (*b*) the chief Roman roads; and (*c*) the various Saxon states.

18. Give the dates of three battles before A.D. 800. State the places where they were fought, the opposing parties, and the results.

G.—*Euclid.*

Second Year Boys.

Revise Propositions XI. to XX., and work 20 deductions thereon.

Third Year Boys.

Revise Propositions XL. to XLVIII., and work 20 deductions thereon.

(N.B.—Practice should be taken each week in working out propositions, not using the letters from A to G).

H.—*Algebra.*

Third Year.—1. Continue working as many problems on Simple Equations as possible.

2. Work the following paper:—

1. If $a = 1$, $b = -2$, $c = 3$, find the value of
$(2a + 3b + 2c)^3 - 8b\sqrt[3]{5a^2 - 4b^2 - 2c^3} - 10$.
Ans. -40.

2. Multiply $6\{a - \frac{2}{3}(b - \frac{1}{2})\}$ by $\frac{1}{3}(2a + 1) + (b + 1)$.
Ans. $4a^2 + 16a + 16 - 9b^2$.

3. Solve $4x - 5(7x - 12) = x - [1 - 2\{x - 3(4 - x)\}]$.
Ans. $\frac{17}{3}$.

4. Resolve into factors $5x^2 - 14x - 3$ and $a^2 + 2a + 1 - x^2$.
Ans. $(5x + 1)(x - 3)$; $(a + 1 + x)(a + 1 - x)$.

5. Find the H.C.F. of
(1) $26a^2b^2x$, $52a^3b^2x^2$, $39ab^3x^3$, $13a^2b^2$. Ans. $13ab^2$.
(2) $6a^2 - 6a^2x^2$ and $2a - 2ax^3$. Ans. $2a(1 - x)$.

6. A bag contains £5 in shillings and half-crowns. After 18 shillings and 4 half-crowns had been taken out, it was found that twice as many shillings as half-crowns were left. How many were there of each at first?
Ans. 50 shillings; 20 half-crowns.

I.—*Teaching.*

Second Year.—Flux's 'School Management,' Chapter VII. The Teaching of Arithmetic.

Third Year.—Flux's 'School Management,' Chapter X. Discipline.

(Prepare answers where necessary to the questions given at the back of book on the subject-matter read.)

Test Questions.—All Years.

Penmanship.—Write as specimen of Large Hand:—Idiosyncrasy, Jurisprudence.

Small Hand:—'In the multitude of counsellors there is wisdom.'

Composition.—First Years should practise the reproduction of a passage of average difficulty after reading once.

Second and Third Years.—Write an essay each week, selecting from the following subjects:—

The month of July.
'Delays are dangerous.'
A winter's evening.
Description of any game.
A visit to a museum.
'Where there's a will, there's a way.'
Describe a thunderstorm, or a great flood.
Compare a sailor's life and a soldier's.

Geography.—1. Draw a memory map of England south of latitude 52°.

2. Give a description of the mountain system of Australia.

3. Compare and contrast Newfoundland and Tasmania.

4. Write a letter describing a week's holiday in the Highlands of Scotland.

History.—1. How was England governed during the monarchy of Henry III.?

2. Write a life of De Montfort, and give some account of his work.

3. Edward I. is sometimes called the Justinian. Why? Give a full account of one important statute passed in his reign.

4. Describe the reduction of Wales.

First Year.

English.—1. Analyse the following passages from Gray's 'Bard':—Lines 23-27, 39-43, 53-56, 63-66.

2. Parse these words:—In vain (32), far (37), dear as (40), no more (43), avengers (46), enough (51), to trace (52), shrieks (56), what (60), obsequies (66), to salute (70).

3. Explain what is meant by a Participle, and give examples.

4. Give example of '*but*' as an adverb, a preposition, a relative pronoun, and a conjunction.

5. Point out the affixes and their force in the following words:—Scholars, goodness, friendship, maidenly, speaker, lambkin.

Arithmetic.—(*a*) Add together $3\frac{1}{4}$, $2\frac{3}{12}$, $1\frac{4}{5}$, $\frac{18}{20}$, $4\frac{7}{12}$.
Ans. $12\frac{61}{60}$.

(*b*) Divide £269 10s. among A, B, and C, so that A shall have five times as much as B, and B eight times as much as C.
Ans. A £200; B £44; C £5 10s.

(*c*) Find the G.C.M. and L.C.M. of 3432 and 3575.
Ans. 143; 85,800.

(*d*) 54 tons 10 cwt. 2 qrs. 12 lbs. @ £9 10s. 6d. per ton.
Ans. £519 8s. $0\frac{111}{1000}$d.

Music.—Answer test questions above.

Second Year.

1. Paraphrase and analyse lines 73–80 of 'The Traveller.'

2. Parse:—Such (73), best (74), and, yet, perhaps, if countries we compare (75), good, given, (79), even (80).

3. Enumerate and explain the different kinds of objective case.

4. Point out the Latin prefixes in the first 30 lines of 'The Traveller.'

Arithmetic.—(*Boys.*)—1. At what rate per cent. per annum will £357 12s. 6d. amount to £438 1s. $9\frac{3}{4}$d. in 5 years at simple interest.
Ans. $4\frac{1}{2}$ per cent.

2. If by selling tea at 2s. per lb. a grocer gains 8 per cent., what per cent. will he gain by selling it at 2s. 6d. per lb.?
Ans. 35 per cent.

3. A man invests $\frac{3}{5}$ of a sum of money in 5 per cent. railway debentures at 120, and puts the rest out at 4 per cent. interest. Find the average return he gets per cent. for his money.
Ans. $4\frac{1}{2}$ per cent.

4. A man puts 3 pints of wine and 5 pints of water in a gallon measure. He then pours out 3 pints of the mixture, and fills up with water. What percentage of wine will be in the second mixture?
Ans. $23\frac{7}{8}$.

(*Girls.*)—1. Simplify $\frac{2\frac{4}{5} - 1\frac{1}{2} + 9\frac{1}{11}}{4\frac{1}{2} - 2\frac{1}{4} + 13\frac{7}{11}}$.
Ans. $\frac{3}{5}$.

2. If a turkey cost $\frac{5}{6}$ of a guinea, and a goose $\frac{3}{5}$ of a turkey, what was the price of a goose?
Ans. 8s. 9d.

3. Add together $\frac{3}{4}$ of 7s. $10\frac{1}{2}$d., $\frac{1}{12}$ of £3 17s. 1d., and $\frac{5}{9}$ of 17s. $6\frac{1}{4}$d.
Ans. £2 16s. $3\frac{13}{18}$d.

4. State the rule for converting vulgar fractions into decimal fractions, and explain your rule by applying it to the fractions $\frac{1}{16}$, $\frac{7}{125}$.
Ans. ·0625; ·056.

Euclid—1. Prove I. 7.

2. Define parallel lines, circle, superficies, equilateral triangle.

Music.—Answer questions above.

Teaching.—1. Give sketch of a first lesson on Long Division.

2. How would you teach Composition to Standard II.

Third Year.

English.—1. Paraphrase and analyse lines 51–60 of 'Essay on Man.'

2. Parse lines 51 and 52.

3. Give some account of English writers before the Conquest.

Arithmetic.—(*Boys.*)—1. Find the difference between the interest on £133 6s. 8d. for 6 months at $4\frac{1}{2}$ per cent., and the discount on £83 due 15 months hence at 3 per cent. per annum. Ans. 0.

2. Find the ratio of $23\frac{1}{3}$ of 7 tons 2 cwt. 1 qr. $9\frac{1}{2}$ lbs. to 21 tons 7 cwts.
Ans. 70 : 9.

3. Find the number of feet in $\frac{3}{10}$ of a mile $+\frac{8}{11}$ of a furlong $-5\frac{7}{22}$ poles.
Ans. 473 feet.

4. Explain the rules for finding the square root of a number of four digits by an algebraical illustration.
Find the square root of $424\frac{9}{25}$.
Ans. $20\frac{3}{5}$.

(*Girls.*)—1. Simplify $\left\{\frac{7\frac{1}{2} + 5\frac{5}{8}}{7\frac{1}{2} - 5\frac{5}{8}} - \frac{7\frac{1}{2} - 5\frac{5}{8}}{7\frac{1}{2} + 5\frac{5}{8}}\right\} \div 3\frac{3}{7}$.
Ans. 2.

2. Find the value of 3·125 of £9 4s. 6d. — ·06 of £17 16s. 3d. + 5·1$\dot{3}\dot{6}$ of £3 9s. 8d.
Ans. £45 11s. $3\frac{3}{4}$d.

3. If 4 cwt. 2 qrs. 15 lbs. of sugar can be bought for £4 6s. 6d., what will be the price of 9 cwt. 3 qrs. 23 lbs.? Ans. £9 5s. 10d.

4. Divide 42·39 by 2·7, ·04239 by 27,000, and 423,900 by ·0027. Prove the first sum by working it by Vulgar Fractions.
Ans. 15·7; ·00000157; 157,000,000.

Euclid.—1. If a straight line falling on two other straight lines make the alternate angles equal to one another, these two straight lines shall be parallel.

2. The angle contained by the bisectors of the angles at the base of any triangle is equal to the vertical angle, together with half the sum of the angles at the base.

Algebra.—1. What is the cost of carpeting a room p feet long, q yards long, at r shillings per square yard?
Ans. $\frac{1}{9}pqr$.

2. Find the value of—

(i.) $\frac{2a^2}{a^2 - b^2} - \frac{a}{a+b} - \frac{b}{a-b}$.
Ans. 1.

(ii.) $\frac{4}{2x^2 + 7x - 4} - \frac{3}{10x^2 + x - 3}$.
Ans. $\frac{17x}{(2x-1)(x+4)(5x+3)}$.

3. Find the square root of $81x^4 - 243x^3 + 367x^2 - 286x + 121$.
Ans. $9x^2 - 13x + 11$.

4. Solve the equations—

(i.) $\frac{3}{7}(4x - 9) - \frac{7}{13}(5x - 12) = 6\frac{4}{11}$.
Ans. $-3\frac{83}{86}$.

(ii. $\frac{3x+1}{4} + \frac{x+1}{x+8} = \frac{9x+8}{12}$.
Ans. 4.

Music.—Answer questions above.

Teaching.—1. Explain any way you know of making clear to the eye the process called multiplying $\frac{3}{5}$ by $\frac{1}{2}$.

2. Shew that Grammar and Composition should be taught simultaneously from the first.

3. What is meant respectively by physical, commercial, mathematical, and industrial geography? Say which of these seems to you most important, and why.

Notes on 'The Bard.'

Warp and woof - The cross threads in any weaving process.
Characters of Hell. - Divination of the future was generally believed to be acquired by the assistance of evil spirits. Certain forms and characters were traced within a circle, and certain words and deeds must accompany the act.
Lines 53–56 - This refers to the cruel murder of Edward II. at Berkley Castle, in Gloucestershire. (The bard is proceeding to relate the evils which will fall upon Edward's descendants.)
She wolf, etc. - Isabella, the faithless and heartless wife of Edward II., who was murdered with her knowledge and consent.
The scourge of Heaven. - Edward III., who distinguished himself in his French ravages. As Isabella was a French woman, it seemed a strange fate that her son should be the ravager of France.
Lines 63–66 - Refer to the sad end of Edward III.
obsequies - Funeral rites and ceremonies.
Sable warrior - The Black Prince, who died before his father.
Lines 71–76 - Are particularly fine. Edward's career is likened to a voyage which starts in most favourable circumstances and ends in ruin and destruction.

The 'Traveller.'—General Analysis.

Lines 1–10 - Dedication to his brother.
,, 11–22 - A touching description of a happy Irish home, characterised by boundless mirth and hospitality.
,, 23–30 - A contrast of the above with his own wandering and homeless life.
(N.B.—It must be remembered that this was largely his own fault.)
,, 31–50 - The duty and privilege of any man to enjoy the beauties of nature.
,, 51–62 - As a miser is never content with what he has, so the poet is not satisfied with the good he sees, but longs for some spot which is consigned to real happiness alone.
,, 63–72 - Where is such a spot to be found? Everybody claims it, from the dweller in the Arctic Regions to the negro in the Tropics.

Lines 73-80 - This is the spirit of patriotism, but if countries and their privileges are examined and compared, it will be found that they all have about the same total of happiness.

,, 81-98 - Nature is a kind mother to all alike, but with Art it is different. The two things cannot be found together, wealth and freedom destroys contentment, commerce lessens honour; each state has its own peculiar idea of happiness, and attaining that, considers all other ideas as erroneous.

(Goldsmith's ideas are very different from those generally accepted now. We consider wealth and freedom compatible with happiness and commerce with honour.)

,, 99-104 - The plan of the poem—to consider the various nations in detail and see what advantages and disadvantages they possess.

,, 106-164 - *Italy.*—(*a*) The country:—Everything that could be desired in climate and soil (105-122).

(*b*) The people:—'Man seems the only growth that dwindles here.' He is luxurious, vain, trifling, untrue, continually planning sin (123-132).

(*c*) Contrast with ancient Rome. Commerce, wealth, art, have all departed.

(*d*) Yet the people having little, are satisfied with little. The pasteboard triumph, the showy procession, childish sports seem to give them happiness. 'Little things please little minds,' and the peasant builds in wretched hovel, in the ruins of some palace, and wonders that anyone could desire more than he has.

(*To be continued.*)

SCHOLARSHIP COURSE FOR DECEMBER, 1895.

Work for the Month.

Continue practice in Reading and Writing as outlined last month.

1. *Spelling.*—250 words from '*Words commonly misspelt*,' or any other good list.

2. *Composition.*—Write one or two essays each week, selecting the subjects from the following:—

(*a*) The use of Colonies to the Mother Country.
(*b*) Moral Courage.
(*c*) Imports and Exports.
(*d*) The practical uses of Electricity.
(*e*) How oft the sight of means to do ill deeds makes ill deeds done.
(*f*) The value of public parks to a crowded city.
(*g*) Street Tramways—their advantages and disadvantages.
(*h*) Intelligence in domestic animals.
(*i*) Town and Country life.
(*j*) A day by the Sea Shore.

Draft an analysis of each before writing, and enter into note book.

Read up the subject, if necessary, but do not refer to books while writing.

3. *English.*—(*a*) Analyse the following passages, and parse words in italics:—

(1) *Such* is the patriot's boast *where'er* we roam,
His first, best country, *ever* is at home;
And *yet, perhaps* if countries we compare,
And estimate the blessings which they share;
Though patriots *flatter, still* shall wisdom find
An equal portion *dealt* to all mankind,
As different *good*, by art or nature *given*
To different nations *makes* their blessings *even*.

(2) Deep midnight now involves the lurid skies,
When Eastern breezes, *yet enervate*, rise,
The waning moon behind a watery shroud,
Pale glimmered o'er the long protracted cloud;
A mighty *halo* round her silver throne,
With *parting* meteors *crossed, portentous* shone;
This in the troubled sky *full oft* prevails,
Oft *deemed* a *signal* of tempestuous gales.

(3) *The more* truly educated a man is, *the* more he is always ready and willing *to learn*. This is because, if he has won for himself the advantages of real learning, he comes then *to realise how very little*, after all, it is ever possible for man *to know*. There is no surer sign of an uneducated man, *however well* informed he may *be, than* the presence in him of the spirit that makes him think he has *no more* to learn.

(4) No reader of Tennyson can have failed *to remark* his *sympathy* with everything human, and the peculiar *grace* with which he expresses it. We feel *as* we read that it is *not only* the poet's intellect that has been occupied in the production of the poems, but *also* his *heart*. The fiercer emotions which wrong and selfishness excite in a generous nature, are *nowhere more powerfully* expressed *than* in his verse.

(*b*) Learn 50 roots and meanings with examples per week.

(*c*) *Literature.*—Enter into a note book brief lives of the following authors, with their chief works, and brief descriptive notes:—Young, Thomson, Watts, Collins, Shenston, Gray, Macpherson, Chatterton, Samuel Johnson, Goldsmith.

(*d*) Revise the grammar of the Noun, fully and completely.

4. *Arithmetic.*—(*a*) Prepare any parts of the theory not known. Work as many problems as possible in watch and clock sums, mixtures, etc.

(*b*) Work the following test papers on last month's work:—

1. At what rate per cent. will £540 amount to £734 8s. in 9 years, simple interest? Ans. $3\frac{1}{2}$ per cent.

2. In what time will 29 half-sovereigns amount to 29 half-guineas at $2\frac{1}{2}$ per cent. per annum, simple interest? Ans. $1\frac{9}{11}$ years.

3. A sum of money amounts in 10 years, at $3\frac{1}{2}$ per cent., simple interest, to £506 15s. $1\frac{1}{2}$d. To what sum will it amount in 15 years more? Ans. £703 16s. $6\frac{3}{4}$d.

4. Find the Compound Interest on £473 for $\frac{3}{4}$ year at 5 per cent. Interest being added to the principal every quarter. Ans. £17 11s. 2·4342d.

5. A man bought a horse and sold it at a loss of 10 per cent.; if he had received £9 more he would have gained $12\frac{1}{2}$ per cent. What did the horse cost? Ans. £40.

6. How much 3 per cent. stock has been sold out at 88, if when the proceeds are invested in £20 shares at 24, paying 4 per cent., the owner's income is reduced by £2 a year? Ans. £3,000.

5. *Algebra* (*Girls*).—Division.
(*Boys.*) Simultaneous Equations (two unknowns) and problems on them.

6. *Euclid.*—Book II. Definitions and Propositions I. to IV.
Practise writing out, not using any letter from A to C.
Be prepared to state each proposition in algebraical terms.

7. *Geography.*—The Australian Colonies. As pointed out last month note-books and sketch maps must be freely used. The note-book must contain a complete digest of the matter to be remembered, illustrated by maps containing all places mentioned.

The chief points are given under the Pupil Teachers' Course in last month's, and in the present, issue. Particular attention must be given to Industries, Towns, and Government.

Memory Maps.—We are able to present our readers this month with the memory maps needed for Scholarship, in a form easy to learn and remember. These should be practised frequently, and an occasional one sent in for criticism.

8. *History.*—Henry VII. Chief points to be noted and read up:—

(*a*) This reign makes the transition from Mediæval to Modern History. Up to this time is known as the Dark Ages, when there was little knowledge, education, or thought, but a continual struggle for power. Henceforth diplomacy largely takes the place of brute contests.

(*b*) Henry's claim to the Throne—the union of the Yorkist and Lancastrian claims.

(*c*) Causes of the nearly absolute power possessed by the Tudors:—

(1) The great baronial families had become impoverished, reduced in numbers, weakened by the long Wars of the Roses, and incapable of strong opposition.

(2) The new nobility created by Edward IV. and Henry VII. were entirely dependent on the Crown.

(3) The Church was lacking in energy and vigour.

(4) The House of Commons was less independent and representative.

(5) The nation was tired of war and longed for peace at any price.

(6) The king rendered independent of Parliament by keeping peace and not requiring subsidies.

(7) The personal character of the Tudors—able, energetic, and assertive.

(*d*) The risings against Henry.

(*e*) Henry's foreign policy and marriage schemes.

(*f*) Home government:—

(1) Suspension of Parliamentary life.

(2) Extension of Royal power by foundation of Star Chamber.

(3) Accumulation of treasure by subsidies, fines, confiscations, benevolences, etc.

(The Star Chamber and its power should be carefully noted, as it played an important part in subsequent history.)

9. *School Management.*—Flux: Chapter X. Discipline.

(*a*) Buildings, Warming, Lighting, Ventilating, Cleaning, Decoration, Furniture, etc.

(*b*) Characteristics and Results of Good Discipline.

(*c*) Punishments and Rewards.

Test your reading by the collection of questions at the end of the book.

10. *Domestic Economy.*—The various ways of preparing food. Articles used for clothing, and their relative values.

11. *Music.*—Terms used in Music.

12. *French.*—Prepare 20 pages of 'Le Trésor.' (For translation, see *Girls' Mistress* weekly.)

Prepare the grammar of the noun, noting especially Gender and Number.

Test Questions.

1. Give a brief account of the authors of the following works, and mention any other of their works you can:—The Shepherd's Calendar, Tamberlane, The Alchemist, Ecclesiastical Polity, The Dunciad, Gulliver's Travels, The Principia, and Robinson Crusoe.

2. What is meant by the 'Augustan Age' of English Literature? Name the chief writers of that period.

3. (*Boys.*) Work the following equations :—

(i.) $\sqrt{(x+11)} - \sqrt{x} = 1$. Ans. $x = 25$.

(ii.) $\sqrt{(3x+4)} + \sqrt{(3x-5)} = 9$. Ans. $x = 7$.

(iii.) $a\sqrt{(b-x)} = b\sqrt{(a-x)}$. Ans. $x = \frac{ab}{a+b}$.

(iv.) $\sqrt{(x+a)} + \sqrt{(x+b)} = \sqrt{c}$.

Ans. $x = \frac{a^2+b^2+c^2-2bc-2ac-2ab}{4c}$.

(*Girls.*)

(i.) Show that $x(x+1)(x+2)(x+3)+1 = (x^2+3x+1)^2$.

(ii.) Multiply together $a+x$, $b+x$, and $c+x$.

Ans. $abc + (ab+bc+ca)x + (a+b+c)x^2 + x^3$.

(iii.) $x^3+4x^2+5x-24 \times x^2-4x+11$.

Ans. $x^5+151x-264$.

(iv.) $x^3-4x^2+11x-24 \times x^2+4x+5$.

Ans. $x^5-41x-120$.

4. Enumerate the English possessions in Asia, east of India, and give some account of their productions.

5. Draw a genealogical table illustrating the descent of the Yorkists and Lancastrians. Tabulate the battles fought, giving in each case the date, place, leaders, and result.

6. What were the chief sources of revenue during the Lancastrian and Yorkist reigns?

7. (*Boys.*)

(i.) Prove I. 48.

(ii.) PQRS is a rectangle, T any point. Show that the squares on TP, TR are together equal to the squares on TQ, TS.

(iii.) T is a point within a parallelogram PQRS, and lines are drawn from it to the angles. Show that the triangles TPQ and TRS are together equal to the triangle PQR.

(iv.) Show that the lines bisecting the external angles of an equilateral triangle are parallel to the sides.

8. (*Girls.*)

(i.) What does milk contain? Say why it is suitable for children. Is there any other article of diet which would serve the purpose equally well?

(ii.) Say how cheese is made, and what kinds of cheese contain the largest amount of nourishment.

(iii.) What are the arguments for and against a purely vegetable diet.

(iv.) What are the special advantages of fish as an article of food?

9. (i.) Name the following Intervals:—

s–m', d–t, m–t, se,–f, re–s, de–s

(ii.) If the first note of the following passages is regarded as *ray*, what will the others become?—

(*a*) l fe s d' m r fe l t d' fe l s

(*b*) s f ta l m f d' ta r' f ta l

(iii.) Which of the following tones is highest in pitch, and which one lowest?

(*a*) f in Key C. (*b*) r in Key G. (*c*) l in Key B♭. (*d*) f in Key A. (*e*) t, in Key D. (*f*) s in Key F. (*g*) r' in key E♭.

Correspondence.

1. Individual assistance will be given as far as possible by advice, solution of difficulties in any subjects, model answers, etc.
2. Specimens of Writing, Paraphrasing, Maps, Composition, etc., will be marked and criticised gratis.
3. To assist students in rural districts, Freehand or Model Drawings will be corrected and marked, with hints for improvement, etc., and returned if accompanied by a postage stamp.
4. As a rule, all replies will appear in the Correspondence Column, but anyone desiring an immediate reply may obtain it by enclosing a stamped, addressed envelope.
5. To ensure an answer in the next issue queries must be sent by the 15th of each month.
6. Name and address of sender, with coupon of current number of the Practical Teacher, and *nom de plume* if desired, must be enclosed.

All communications and queries with regard to these courses to be addressed to Arthur T. Flux, 12, Lower Park Road, Belvedere, Kent.

Answers to Correspondents.

E. H. C. (Scarning).—I cannot tell you in what towns University Extension Lectures in English Literature are held. Write to the Secretary, University Extension Lectures, Examination Schools, Oxford. There is, I believe, no regular time of beginning the courses. They are usually held in the winter months.

Subscriber (Clitheroe).—Write to the Training College for a Syllabus. The Examination in Religious Knowledge is held the day before the Scholarship Examination starts. I may be able to give you some advice in the matter of Text-books.

A. B. C.—The term 'A General Principle' is used with a great many different significations. It may be defined as a law or rule, the truth of which is apparent without proof, and which is generally accepted. Yes, marks are given for Practical Skill in Teaching—120, I believe.

Rusticus.—You must Read and Recite at the examination of your school next preceding the examination. Write to 'The Secretary, Education Department, Whitehall, London, S.W.' for a Scholarship Syllabus for 1895.

Answered by Post.—C. D. (Linton); V. E. S. (Lincoln); G. V. (High Wycombe); Rossendale (Bacup); W. M. (Coatbridge); H. B. (Whitehaven); M. O'K. (Holywell); E. A. P. (Rugeley).

We understand that Messrs. J. Curwen & Sons, of 8 and 9, Warwick Lane, London, E.C., have just purchased the copyright of the well-known Manual of Music written by Dr. R. Dunstan, of the Wesleyan Training Colleges, Westminster and Southlands.

The proprietors of the 'Waterloo' Series and other educational works hitherto published by Messrs. W. H. Allen & Co. have decided, owing to the increasing business, to open their own publishing office at 4, Adam Street, Strand, where they will carry on the business under the name of Abbot, Jones & Co., Limited.

NOTES AND NOTIONS.

BY RICHARD WADDINGTON.

THE high water-mark of Conference as a Pedagogues' Parliament has been fully recognised by the Press in dealing with the doings of the Manchester Conference. In quantity and in quality the references to the work of the Conference have been generous, whether hailing from north, south, east, or west. Here and there one finds a discordant note which only serves to enhance the harmony of the rest.

'Report me and my cause aright,'

has not infrequently been the demand of teachers in the past, but of the Manchester Conference the request was unnecessary. Why? I believe the reason lies in the Agenda. The subjects dealt with were largely bereft of technicalities, and were of public import. The public had an interest in the teachers' views on superannuation, child-labour, reasonable security of tenure, the problem of Rate-aid and State-aid, and the Code. So long as our Conference devotes itself mainly to the broad principles of National Education there will be no necessity to plead for public notice—the public mind will turn with readiness to the opinions of the associated teachers.

* * * * *

IT was to be expected that Mr. Organ's paper would rouse the anger of many. It would have been painful had there not been one righteous manager in the land who is not content to accept the severe castigation of the Law Clerk. That there has not been more protestation makes me shudder. So serious and unmistakable are the charges that the wonder is that every body of managers, and especially every Diocesan Board of Education, has not demanded the withdrawal of them. I confess that to me the silence is ominous and painful. The practical and common-sense conclusion is that the refutation of the charges is impossible in far too many cases. Mr. Organ admits as readily as any one the existence of a large number of well-managed, both financially and otherwise, voluntary schools. His object, and the object of all true supporters of the dual system, is the purging of the system of this very undesirable element that does so much to injure religion, and bring odium on voluntary schools. There is no desire to commence a crusade against any schools that are properly conducted, but war ought to be waged against the diversion of money voted for educational purposes into other channels. Nobody suffers more by this than the teachers.

* * * * *

THE first meeting of the New Executive was a long one, only concluding in the middle of the twelfth hour. It was a record meeting in many ways. For the first time it was '*Ladies* and gentlemen,' and there were new members galore to welcome, and old ones to regret. Messrs. Greenwood and Wild were absent through indisposition. When I think of the unselfish devotion of men like these, and of the selfish indifference of the non-Unionists, words fail to fully depict my feelings. Think how much of leisure has been sacrificed by these men during the last quarter of a century to build up a Teachers' Union that was probably less necessary to them than to others. I hope to see Messrs. Greenwood and Wild back again in vigorous and robust health very shortly.

* * * * *

THE chairmanship and vice-chairmanship of the various committees of the Executive have undergone some change. In some cases the retirement of the former officer has brought this about, and in others the poll has been against the former occupant. Messrs. Clancy and John take up onerous duties in the Parliamentary Committee, and Messrs. Bowden and Gill in the Secondary Education Committee. Mr. Horobin is called to the Law Committee, a call that will give him scope for his untiring energy, and Messrs. Jackman and Gale man the Organization Committee of the Union—the most important of the many important phases of Union work during the present year. Forty thousand for Brighton is no wild dream if the right methods are pursued during the next few months. Never before have there been such possibilities before the Union as at present. With the Superannuation and Tenure problems awaiting solution, the appeal ought to be made to all teachers to come over and help us. Let us have three months' hard missionary effort and the forty thousand will be enrolled before the Conference assembles at Brighton. Who will help?

* * * * *

'There's but the twinkling of a star
Between a man of peace and war,'

was apparent when the Chancellor of the Exchequer failed to provide for Superannuation in the Budget. Thousands of teachers felt that the point had been reached when human endurance becomes a sin. Bitter disappointment raged throughout pedagogy. 'The last hope gone' was the cry of many patient waiters on the Government's fulfilment of its oft-made promises. 'Hope springs eternal in the human breast,' and teachers, being human, clung to the words of Sir W. Harcourt that the Government were hopeful to legislate on the Report of the Departmental Committee. I am not without hope that Mr. Acland will be able to fulfil his long-cherished ambition to place a reasonable scheme of Superannuation in force before he leaves Whitehall. I believe a Bill will be introduced, and it is because I believe this that I am so anxious to get the forty thousand members of the N.U.T. Once the Bill is introduced we shall want all our power and influence to secure its easy passage through the House. It will be a question of time, I fear, and we must accelerate its progress.

* * * * *

BRIGHTER days are in store for the children of the factory districts. Mr. John Burns has given notice to move a new clause on the Factory and Workshop Bill prohibiting all employment before 13 years of age, and Dr. McGregor 'goes one better' by moving to substitute 14 for 13. To this Messrs. Cohen, Gorst, and Mundella reply with 12 as the age. The only difference between Sir John Gorst and Mr. Cohen is in the date of enforcement. Sir John Gorst fixes the first of January 1897, while Mr. Cohen fixes the first of January next. But it is

very probable that Mr. Mundella holds the final amendment, which is—

'On and after the first day of January, one thousand eight hundred and ninety six, no child under the age of twelve years shall be employed in a factory or workshop. Provided always, that any child lawfully employed under the principal Act, or any Act relating to the employment of children, at the time that the provisions of this section come into operation, shall be exempt from its provisions.'

When the Bill leaves the Grand Committee on Trade it is to be hoped that, if Mr. John Burns fails to carry 13, Mr. Mundella will have succeeded in inserting this small recognition of the pledge given at the Berlin Congress.

* * * * *

Can I appeal to my readers to give us a hand in this righteous movement? If the clause is to be engrafted in the Bill it will be without the aid of the M.P. from the factory district. There is little difficulty in convincing the member for a non-manufacturing area that the change is necessary. Herein lies the solution. Will every teacher write to the M.P. for the district in which he, or she, resides? I feel sure my readers will lend a hand in so good a cause. If there is any information wanted, my address is St. James' School, Bolton.

* * * * *

Here is a genuine piece of composition. The original lies before me; in fact, I witnessed its production.

'Life of Samuel.

Samuel was the son of Adam and he asked Samuel if he could go with him. He did do and they went to have a walk through the country. He told him not to eat of that tree and he did so that he was turned out of the garden and he was not to come in the garden any more. He wanted to go and live in the house again and he would not let him go in again. He told him that he eaten of the wrong tree. Hannah gave it me and I did eat.'

* * * * *

The Evening School Code for 1895 is not much unlike the Evening School Code for 1894. Two pages suffice for a summary of the alterations, which are generally alterations of phraseology. After the drastic alterations of two years ago, a period of restful inactivity is to be appreciated. True, there is much to be desired in the Evening School Code even yet. Variable grants hardly agree with a proper system of Continuation Schools, and the method of examination in Drawing might be improved with advantage to both the Department and the schools. But South Kensington moves slowly toward a rational system. All the fossilized educational methods seem to cling tenaciously to South Kensington.

* * * * *

Which reminds me that the long-looked-for revisal of the Drawing Syllabus, promised last December by Mr. Acland, is still awaited. Is the fixed annual drawing examination to remain in schools that come under Art. 84 of the new Code? If so, the full advantage of the new order will not be taken by the teachers. With the reduced needlework requirements the drawing presses severely in mixed schools. Too much is required, especially in the higher standards, and what is required is not always suited either to the district or the scholar. The everlasting drawing of the bold curves encouraged by the Department gives no scope for ingenuity or design. Individual taste must give way, as usual, to the Department's cast-iron syllabus.

* * * * *

In any standard two exercises are sufficient to be accomplished in the course of a year. The work of the fifth, sixth, and seventh standards at present is simply excessive, and out of all proportion to the time that the subject ought to engross of the child's school life. There should be choice of syllabuses and separate syllabuses for small schools. How the teacher, working single-handed, gets through the requirements is a mystery. Remembering that in the old days when the subject was optional, and only the best children were presented, the Department's regulation, that a scholar must not take up more than two subjects in one year—it is simply astounding that the powers that be at South Kensington should continue to require three much harder subjects in the fifth and higher standards. But teachers have ceased to wonder at the eccentricities of South Kensington. A pupil teacher is only allowed to take up two second grade subjects in one year, while a scholar in the sixth standard is *compelled* to take up three subjects equal in difficulty to the second grade.

* * * * *

Is Art. 84 of the new Code to be generously enforced in all inspectorial districts? It is no secret that there are inspectors who look askance at the new regulation. The fact that during the last twelve months there has been no use made of the power to exempt infants' schools in certain districts leads me to believe that nothing but outside influence will bring some inspectors to a right view of the situation. Every school that is not warned as likely to be declared inefficient ought to be placed under the new conditions. It is not sufficient that schools receiving the 'higher grants' should be excused only To my certain knowledge many of the best schools I ever knew did not receive recognition in the shape of higher grants. And it is just these schools that would thrive best under the new conditions. It is to be hoped that pressure will be brought to bear on the Department to ensure a full and generous trial of Art. 84 both in letter and in spirit.

* * * * *

Mr. Acland has appointed another inspector, and again the experience bought within the school would appear to be the last of the qualifications of Mr. Ward, as of the other appointments save Mr. Northrop's. Isn't it time we emulated the factory operative in this matter, and made our presence felt by pressure at the ballot-box? The Government boasts on the hill-tops of the appointment of factory inspectors taken straight from the spinning-room, even if to do this part of the Civil Service Examination has to be excused. The teachers go on crying as one crying in the wilderness for the appointment of inspectors who have practical acquaintance with the schools. There are men and women at present working in the Primary Schools possessing high University distinctions in addition to wide practical experience of schools and scholars, and their claims go unrecognised year by year. There is but one way to alter this, and it is time teachers found salvation.

To the right and to the left I hear 'What are you doing about Varied Occupations?' 'Emulating the sailor's parrot—thinking,' is my answer. Object Lessons and Suitable Occupations do not come into force until the school year commencing after August 31st next. My school was examined in February last, and my next school year will commence in February 1896. If the Code is not altered on that date I shall commence Suitable Occupations. I have already substituted Object Lessons for geography in the first three standards.

* * * * *

For my Suitable Occupation I am halting between crayon work as an addition to the drawing, and 'string laying.' Perhaps I had better explain 'string laying.' Give each child a piece of string about a yard in length. Wet each child's slate, and then at the direction of the teacher let the class form figures with the string. At first it will be well to confine the work to geometrical figures, but after a time the children will be able to form animals and familiar objects. It is interesting, cheap, and educational, *and let me add is not original,* for I have seen it in more than one infants' school.

* * * * *

I have to acknowledge a host of letters received since the Conference. The kindly references to my candidature for the Vice-Presidency of the N.U.T. and the offers of active support are not forgotten, if not individually acknowledged. Several of my readers are anxious to assist me in raising the age for half-timers. Very many thanks; there is every hope that this year will nearly end my mission on the half-timer. And then—well, I think I shall have to become a truly Rural, for one will feel so lonely without something to agitate for after this half-time controversy.

'JOLLY GOOD FELLOWS.'

A PLAY FOR BOYS.

BY JOSEPH DESPICHT.

Author of 'Should Men Wear Hats?' 'In 1999,' etc.

Persons represented:—

Bob Brown - - -	'Head Boy' in Doctor Daymond's Grammar School, and winner of 'University Scholarship.'
William Ellum - -	'The Young Squire.'
Horatio Nelson - -	'The Little Lord.'
First Frenchman (afterwards William Kirby) -	*Clairvoyant.*
Second Frenchman (afterwards Robert Cummings) - - - - -	*Clairvoyant.*
Arthur Hamilton -	Fifth form boy.
A Fourth Form Boy.	
Sixth Form Boys, *ad lib.*	

Scene.—Head Boys' Class Room in Dr. Daymond's Grammar School.

Time.—7 p.m.

Discovered: Bob Brown seated on a high chair behind an ordinary school table in Back Centre. Over his head is written in large characters on a sheet of cardboard, 'Success to Bob.' A few simple decorations are hung about. Two parallel benches, the back rather higher than the front, extend at an obtuse angle on the right, and two on the left. About these are grouped from twenty to thirty boys. A large hamper and four brown jugs or pitchers are on the floor beneath the table. On the Right Front is a Master's desk or rostrum. Nelson and a few others stand disputing in the Front Centre. As the curtain rises, loud cries of 'Yes! Yes!' 'No! No!' are heard.

1st Boy: I say Nelson major has no right to be in here!

Nelson: And I say I have as much right to be in here as any one of you!

All (except Brown and two others): Turn him out! Turn him out!

Nelson: Turn him out, did you say? Who's to do it? The Doctor gave the Sixth leave to use the Head Boys' Room this evening, and *I'm* a Sixth!

2nd Boy: No, you are not, Nelson! You are a *Lower* Sixth; and by the traditions of the school are not entitled to the privileges of the *real* Sixth! (*Cries of 'Hear, hear!'*)

Nelson: The Lower Sixth have been promoted from the Fifth for brains—things that you fellows seem untroubled with—and I'm here to stand up for the rights of intellect? (*Cries of 'Indeed!'*)

3rd Boy: It's a shame that such brats should be allowed to pester the Sixth at all! It was only through some fad of the new Under-master's that the idea was ever broached. It's a pity he did not stop at Rugby—*we* should never have sent for him! (*Cries of 'Hear, hear!'*)

Nelson: Look here, you fellows, I know Brown gives his farewell banquet to-night, but I cannot help that! I've been chosen by the Lower Sixth to come here to assert our right to be considered Sixth Form, and I'm not going to shirk the duty!

4th Boy: No doubt Mr. Bainbridge let him in, for the door's been locked ever since we dismissed at noon for the Half!

5th Boy: Well, *he'll* soon get *his* reward!

6th Boy: How do you mean, Smith?

5th Boy: Why, as there was to be a half-holiday, the Doctor gave the Fifth leave to go to the creek to bathe. Mr. Bainbridge was to accompany them, as the water at Castle Coot is dangerous, you know. Well, the new Undermaster doesn't swim half a dozen strokes, so some of the fellows have arranged to give him a ducking and a fright at the same time! (*Looks at watch.*) I should think they are almost back by this time, so look out for squalls!

Nelson: I say the new Undermaster's a brick! and if he cannot swim six strokes he's got a cool head and a strong arm, and I pity the fellow who first tries the ducking business!—no good can come of it, and terrible harm may! At any rate, if you have anything to say against Mr. Bainbridge, show your spirit by saying it before his face, not behind his back!

A few: Hear, hear! So say I!

7th Boy: Turn the shrimp out for his impudence!

Several boys (threatening Nelson): Now, sir, out you go!

8th Boy: No, no! Not a lot of you! I say it would be cowardly for more than one to touch him! Leave him to Hooper, he's about his fighting weight!

9th Boy (Hooper): Now, little lord, are you going to leave this room?

Nelson: Certainly not! I'll put my head in a sack. I'll stand on my cranium in a corner! I'll be as deaf as a post or as dumb as a fish; but leave this room I will not!

Bob Brown (rising): There, there, boys! Let the little lord remain! He deserves some consideration for his pluck! I shouldn't like to have anything approaching a rumpus in here on my last night. Let the question of the Sixth Form privileges be settled by the Doctor in the morning.

All (settling into seats): All right, Brown! That's better! That's better!

1st Boy: Shake hands, little lord; you may stay for all I care! And, Brown, old fellow, I'm sorry to have shown any temper on such a night as this. Let us hoist up the hamper and bury our differences in plum cake and sausage rolls! (*Cries of 'Hear, hear!'*)

10th Boy: Yes! and drown our sorrows in some fizzing ginger-pop!

1st Boy (to Hooper): Catch hold of him! (*These two hoist Nelson on to the Master's desk or rostrum at Right Front.*) There, Nelson, you sit aloft, 'like Patience on a monument smiling at' sweets you dare not touch!

Nelson: Never mind me! See! I victualled the garrison before commencing operations! (*Takes from his pocket a bag of tarts and a bottle of ginger beer—All laugh.*)

Bob Brown: Servitors, hoist up, and set the ball a-rolling! (*Four boys lift the hamper on to the table, strings are cut, and bags of cakes produced.*) There you are, lads, help yourselves to whatever comes first! We shall get to the bottom in time, as the cow said when it went over the precipice! (*The same 'servitors' help the others to cake, apples, pears, etc.*)

10th Boy (*munching cake*) : I say, Brown, old fellow, these cakes are very nice ! Are they your own make ?

Bob Brown : No, my boy, not exactly. They're on hire from the pastry-cook,—but why do you ask ?

10th Boy : Oh ! I observe they are so nicely 'Browned'—that's all ! (*Boys go on eating for a few moments.*)

Nelson (*leaping suddenly from rostrum*) : Hush ! What was that ? Did you hear that awful shriek ?

All : No ! I heard nothing ! Nor I ! Nor I !

Bob Brown : What do you mean ? No sound reached me !

Nelson : I thought I heard a shriek like the cry of a drowning man !

5th Boy : It's his fancy. He's thinking of the party at the Creek. You know the little lord's as nervous as a cat at the *thought* of water !

Nelson : I must have been dreaming if none of you heard it ; but strange to say the voice sounded like the new Undermaster's !

5th Boy : Well, that's all right, for Castle Coot, where the Fifth are bathing, is three miles from here ! So don't let the little lord's nerves spoil your appetites ! Drive on !

10th Boy : Bob, old fellow, pardon the unpardonable impertinence of the remark, but, *I'm dry!* (*Cries of 'And I!' 'And I!'*)

Bob Brown : I beg *your* pardon, gentlemen ! Servitors, pass the rosy nectar ! By the way, I hope you have not forgotten your mugs !

Several : Not I ! Not I !

Others : Nor I ! Nor I ! (*Each boy produces a mug of some description, from a gallipot to a silver tankard. The servitors, as before, help the others to lemonade from the pitchers beneath the table.*)

Bob Brown (*as they eat and drink*) : But I don't see Kirby primus or Cummings septimus ; they promised to join the party !

The Young Squire (*seated on left of Brown*) : I knocked for them as I came along the corridor ; but they said they thought they'd a touch of the French measles, and would join us a little later on !

Bob Brown : That's all right ! They are up to some mischief as usual, I know !

10th Boy (*holding up broken saucer*) : Mr. Brown, I really must apologise for the cut of my mug ! You know it's no use asking the servants for the loan of one. So many have been broken on these nights that 'The Lady Bountiful,' so generous in other things, has at last refused to lend any more glasses or mugs ! My shaving-pot has the flavour of Sapolio, my water-bottle and tumbler had a desperate encounter yesterday morning and broke one another up into little pieces ! Moreover, I'm reduced to such a miserable state of impecuniosity that, as the poet says, 'I haven't a brown to buy a bit o' bread with, Let alone a' tin mug ! (*Turns out empty pockets.*) Consequently, I have been brought to the absolute necessity of borrowing a saucer from my friend Mr. Flowerpot, who has his summer residence on the Doctor's window-sill ! You are sure you don't mind, any of you ?

All : No, no ! That's all right, old chap ! We're not proud !

10th Boy : You won't feel slighted, will you, Brown ?

Bob Brown : No, no, Lamb ! Not at all ! Drink, pretty creature, drink !

10th Boy : Thanks ! (*Takes a draught of lemonade—all laugh.*)

The Young Squire (*jumping on bench or table*) : Now, boys, are your mugs all full ? As second on the list for the University Scholarship, I rise, according to custom, to propose success to our brilliant schoolfellow, Bob Brown ! (*Loud cheers.*)

He has given us all a good thrashing, but we bear him no ill-will ! (*Hear, hear !*) I say it's an honour to be beaten by a boy like him ! (*Hear, hear !*) You know, as well as I do, we have been beaten fairly and honestly, and we forgive him for it, don't we ? (*Yes, Yes !*) Only one could win the scholarship, and the best man amongst us has got it ! (*Hear, hear !*) No boy ever saw him do a mean trick or show a spiteful temper ! And, I know, if any one of you or I had beaten him, he would have wished us joy of our success from the bottom of his heart ! (*Loud cheers.*)

If he goes on as he has begun—don't stop eating, any of you—he will undoubtedly become as illustrious as any of his ancestors ! (*Hear, hear !*) These same ancestors, if my information is correct, were certainly remarkable people ! Consulting the family boot-tree, I find that one Jeanette la Brunette—otherwise Jenny Brown—came over, as all respectable ancestors did, with William the Conqueror, in the capacity of washerwoman to His Majesty ! (*Bravo !*) In this position she so distinguished herself that she was given in marriage to the accomplished nobleman who blacked the king's boots ! (*Laughter.*) In recognition of their valuable services, a plot of ground was given them in London, opposite the entrance to Billingsgate Market, on which they were permitted to raise a large and commodious coffee stall ! (*Bravo, Squire !*)

For some centuries, they and their descendants continued to discharge the honourable duty of supplying early risers with dishes of coffee and squares of toothsome cake ! In this way the Browns accumulated—(*Hear, hear ! Bravo !*)—the family of Brown, I mean, for one Brown always married another Brown—the Browns accumulated a large fortune, till next we hear that one of them in the reign of Henry VIII. actually took a 'Ham-and-Beef shop' in the Old Kent Road on his own account ! (*Laughter, in which Brown joins.*)

Since then, the Browns have gone everywhere, and done everything ! When things looked up they became aristocratic, and spelt their name with an 'e,' 'B-r-o-w-n-e,' sometimes going so far as to join it with another name, as 'Willoughby-Browne,' and so on ! But, when fortune frowned, we find them again dropping the 'e' at the tail end, as a piece of grandeur they could not afford to keep up ! (*Hear, hear !*)

All the world knows that a Brown fought at Killiecrankie, and when both his legs were blown away by a cannon-ball, he turned upside-down and continued to fight on his head ! (*Laughter.*)

One, a corporal, fell at Vinegar Hill, with his back bravely facing the foe ! (*Good again, Squire !*) Many Browns were picked up on Waterloo, some of the family being in circulation to this day ! (*Slaps his pocket.*) One illuminated the Church, acting for years as under-beadle at Canterbury Cathedral ! (*Loud laughter.*) Only one of the family has ever brought disgrace upon the name. But as the Government gave him a free passage abroad, for taking what was somebody else's to be his own, why, we won't mention that ! (*Hear, hear !*)

But our host's more immediate progenitors have mostly distinguished themselves in physic, till no powder, potion, or pill will now go down, that bears not the beautiful name of Brown ! (*Bravo !*)

Who can wonder, then, that our own Bob Brown, whose dad has sent us the buns that are now choking you, should prove himself such a chip of the old block ? Fill up your mugs, and let us wish him the success he so well deserves ! Now, are you ready ? Musical honours, mind !

All rise and sing—

"For he's a jolly good fellow !
For he's a jolly good fellow !
For he's a jolly good fellow !
And so say all of us !
With a hip, hip, hip, hurrah !
With a hip, hip, hip, hurrah !
For he's a jolly good fellow !
For he's a jolly good fellow !
For he's a jolly good fellow !
And so say all of us !
Hip, hip, hurrah ! Hip, hip, hurrah ! Hip, hip, hurrah !"

(*Bob Brown rises to speak—loud applause.*)

Bob Brown : Dear boys, you are all too good ! (*No, No !*) I don't deserve a hundredth part of what has been said—especially the charming pieces of information about my noble ancestors ! (*Hear, hear !*) Fortunately, the beneficent unwritten rules of the old school expressly forbid one in my position making a speech. It would be too painful. All I can say is, that you are a set of the jolliest fellows in the world, and I'm proud to be one of you ! (*Bravo Bob !*) Thank you one : thank you all : again and again ! But, while assuring you that I am at least the *second* of my race who has been *transported*, let me remind you that the banquet to-night is not wholly provided by my dad, or borrowed of the pastry-cook. The Doctor's wife, 'The Lady Bountiful,' has, as usual, given the pitchers of luscious lemonade ; and it is as well she did—take a drink—or some of you fellows would never have survived this night ! (*Laughter and 'Hear, hear !'*) Fill again your mugs, and join me in wishing health and happiness to the Doctor and 'The Lady Bountiful' !

All (*standing*) : The Doctor and 'The Lady Bountiful' !

11th Boy : Especially 'The Lady Bountiful' !

Bob Brown : Musical honours, mind ! Now, off you go !

All sing : For *she's* a jolly good fellow, etc., etc. Hip, hip, hurrah ! Hip, hip, hurrah ! Hip, hip, hurrah ! (*Loud laughter. During the laughter loud knocking is heard at the door.*)

12th Boy : Hush ! Hush ! It's Mr. Bainbridge and the Fifth back from bathing ! Look out for yourselves ! I wonder if he's still dripping !

13th Boy (*speaking rapidly*) : No more jollification to-night if the plot has been successful ! You may all expect a hundred lines of Virgil for having even heard the rumour ! (*More knocking.*)

Bob Brown (*rapidly*) : Never mind, lads, I can answer for it that the vast majority of us knew nothing of it till it was probably all over ! (*Knocking.*) Turn the key, janitor. (*Boy goes to door.*) Can't you hear the water trickling ? Fancy, three miles in wet clothes !

All : Cave ! Cave ! Hush !

Enter Kirby and Cummings disguised as French 'clairvoyants' in full evening dress, pointed beard, moustache, crush hat, swallow-tail coat, buckle shoes. Loud laughter as they bow and flourish their hats.

1st Frenchman (*Kirby*) : Good evening, leetle gentlemens !

Nelson : I beg your pardon ! We are little chips, not leetle gentlemens !

1st Frenchman : Pardonnez-moi ! Your langveege ees so strange, I no comprehend, but I veel say, leetle sheeps ! Mon ami et moi, ve vere stop at ze hotel là-bas, an' ve 'ave 'ear zat you 'ave a bonfire at ze School of Grammaire to-night.

Nelson : This is a beanfeast, not a bonfire, Monsieur !

2nd Frenchman (*Cummings*) : Mon ami vould veesh to say, beanfeast !

1st Frenchman (*to second ditto*) : Merci ! (*To the boys*) Pardonnez-moi, I should veesh to say, beanfeast ! So ve go to ze good Docteur Jourmong !

Nelson (*sharply*) : Doctor Daymond !

2nd Frenchman : Mon ami vould veesh to say, Docteur Daymong !

1st Frenchman (*to second ditto*) : Merci ! (*To the other boys*) Ve go to ze Docteur Daymong, and ve say, 'Ze boys 'ave some beanfeasts zis evening ; may ve be permitted to give ze ugly young scamps —— '

All : Ugly young scamps !

2nd Frenchman : Mon ami vould veesh to say, ze bootiful leetle sheeps !

1st Frenchman (*to second ditto*) : Merci, mon ami ! (*To the boys*) Pardonnez-moi ! 'Ze bootiful leetle moutons some amusement zis evening.' An' ze docteur say, 'If ze silly garçons ——'

All : Silly !

2nd Frenchman : Mon ami vould veesh to say, ze pretty boys.

1st Frenchman (*to second ditto*) : Ees it not ze same sing ? He say, 'If ze pretty boys are agréable ve 'ave 'ees permission !'

Nelson : But what's your show ?

1st Frenchman : Mon ami and your 'umble servante 'ave ze second sight ! Ve can tell every joli boy 'ees name, 'ees age, and 'ees caractère !

Bob Brown : That will do, boys ! We've got an hour to spare—the speeches are done—shall we let the Frenchmen stop ?

All : Yes ! Yes ! Let us have some fun !

Nelson : I should like to know the price first !

1st Frenchman : You shall see ze show ; and zen mon ami vill bring round ze chapeau—you can pay vat you please !

All (*laughing*) : That will do ! Ha ! Ha ! Vat 've please, eh ?

The Young Squire ; Mind, you said, "Vat ve please !"

2nd Frenchman : Zat ees so, leetle sheeps !

Bob Brown : Here, take my seat and commence operations ! Servitors, clear away the kickshaws till supper-time !

(*The same servitors clear the table—the boys put their mugs out of sight. 2nd Frenchman sits in Bob Brown's chair. 1st Frenchman stands in front.*)

1st Frenchman : Yo'ng gentlemens.

Nelson (*loudly*) : Little chips !

2nd Frenchman (*rising and gesticulating*) : Mon ami vould veesh to say, leetle sheeps !

1st Frenchman (*to second*) : Merci, Gustave ! (*To the boys*) Pardonnez-moi, mes enfants ! Mon ami ici 'as ze gift extraordinaire of ze second sight. Look ! I blindfold 'im viz zis mouchoir ! Voilà ! (*Blindfolds him.*) An' now he can tell me all vat nobody 'as got ; an' he can tell me all ze names an' ze ages zat never you had ! Look ! (*Pats Nelson sharply on the head.*) Kindly tell me, sire, ze name of zis leetle man !

2nd Frenchman : Nelson !

1st Frenchman : Vat age 'as he ?

2nd Frenchman : Fourteen years, nine months, tree veeks ! (*Nelson nods as much as to say 'Quite right.'*)

1st Frenchman : How much money ees in 'ees pocket ? (*Turns a pocket inside out.*)

2nd Frenchman : None ! (*Pronounce 'non.'*)

1st Frenchman (*to Nelson*) : Ees zat so ?

Nelson : Quite right, old chappie !

All (*laughing and clapping hands*) : Bravo ! bravo ! (*Frenchmen bow.*)

1st Frenchman : Gustave ! be so good to tell me vat ees ze name of zis leetle monkey—leetle sheep, I vould veesh to say ! (*Touches 5th boy.*)

2nd Frenchman : Cyril !

1st Frenchman : How old ees he ?

2nd Frenchman : He vas fourteen years yesterday.

1st Frenchman : Did he give ze boys a beanfeast ?

2nd Frenchman : No ! (*All laugh—cries of 'Shame !' 'Miser !' 'Stingy !'*

1st Frenchman : How much money ees in 'ees pocket ? (*Taps a pocket.*)

2nd Frenchman : None !

1st Frenchman (*to 5th boy*) : Ees zat so ?

5th Boy : Yes, bad luck ! (*A laugh.*)

All : Bravo ! bravo !

1st Frenchman (*bringing 'The Young Squire' to the front*) : Kindly tell me, Gustave, vat zis boy 'as got in 'ees pocket !

(*The Young Squire takes the following articles from his numerous pockets and hands them one by one to 1st Frenchman.*)

1st Frenchman (*to 2nd Frenchman*) : S'il vous plaît ?

2nd Frenchman : A knife vis no cutters !

1st Frenchman (*as before*) : S'il vous plaît ?

2nd Frenchman : A piece of plom cake !

1st Frenchman : S'il vous plaît ?

2nd Frenchman : Von apple vis von bite out of !

1st Frenchman : S'il vous plaît ? (*Holds up crumpled paper.*)

2nd Frenchman : A letter from his mozère !

1st Frenchman : S'il vous plaît ?

2nd Frenchman : Some bit of toffee is vat you call zat !

1st Frenchman : S'il vous plaît ?

2nd Frenchman : Some string ! (*Go on as before.*) A mug ! A mouchoir—very black ! And a leetle vite mouse vich ees dead ! (*Loud applause—Frenchmen bow.*)

1st Frenchman (*taps all his pockets*) : How much money 'as he in 'ees seven pockets ?

2nd Frenchman : None !

1st Frenchman (*to the Young Squire*) : Ees zat so ?

The Young Squire : Quite right, Gustave !

All : Bravo, Frenchy !

1st Frenchman (*touching 10th Boy*) : Vat ees, vill you kindly tell me, ze name of zis old gentleman ?

2nd Frenchman : Ees name is Albert—he 'as ze birch very very often ! He vears a black tie vis yellow spots—zere ees a brass bouton at ze end of 'ees vatch-chain ! (*All laugh as the button is shown.*)

1st Frenchman : Vere ees ze vatch ?

2nd Frenchman : 'Ees oncle down town takes care of it for 'im !

1st Frenchman : How much money ees in 'ees pockets altogezer ?

2nd Frenchman : None !

1st Frenchman (*to 10th Boy*) : Ees zat so ?

10th Boy (*dejectedly*) : Quite right ! (*Cries of 'Bravo !'—Frenchmen bow.*)

1st Frenchman (*touching another*) : Vill you be so good enough, Gustave, to tell me how zis boy calls 'imself ?

2nd Frenchman : Skeetles !

1st Frenchman : Skeetles ! I ask you, sire, vat zis boy calls 'imself !

2nd Frenchman : Oh, pardon ! He calls 'imself 'Beere,' but ze ozer boys call 'im 'Skeetles' ! (*Applause.*)

1st Frenchman : How many feet 'as zis boy in 'ees boots ?

2nd Frenchman : Two !

1st Frenchman (*pointing to boy's feet*) : Von, two ! How many eyes 'as he in ze back of 'ees head ?

2nd Frenchman : None !

1st Frenchman (*pats back of boy's head*) : None ! How many fingers 'as he on ze left 'and ?

2nd Frenchman : Four fingers and von som !

1st Frenchman (*touching fingers and thumb*) : Von—two—tree—four fingers, and von som ! (*Cries of 'Shame !' 'It's a fraud !' etc.*) How much money—— Never mind zat zis time, I sink it ees always ze same ! Vat is remarkable about zis boy ?

2nd Frenchman : He owes von sheeling to Kirby and sixpence to Cummings since von month ago and 'as forgot to pay it !

1st Frenchman : I ask you, Gustave, for somesing remarkable !

2nd Frenchman : Pardon ! I forget ! Zat is not remarkable ! Zis young scamp always owes somesing to everybody ! (*To the other boys*) Ees zat so ?

All : Hear, hear, Frenchy ! Give it him ! (*Applause.*)

1st Frenchman (*skipping from one to another*) : Please tell me quickly vat I touch ! Zis boy's head—vat ees it ?

2nd Frenchman : Ze head of a boy !

1st Frenchman : Zis boy's nose—vat ees it ?

2nd Frenchman : Very long !

1st Frenchman : Vat ees ze colour of zis blue cravate ! (*Louder.*) Dis donc ! vat ees ze colour of zis blue cravate ? (*Very loudly.*) Bah, dis donc ! vat ees ze colour of zis blue cravate ?

2nd Frenchman : I cannot tell, it ees so shabby ! (*All laugh.*)

1st Frenchman (*taking a boy's watch and chain*) : Vat ees at ze end of zis vatch-chain ?

2nd Frenchman : A vatch !

1st Frenchman : Vat ees inside ze vatch ?

2nd Frenchman : Ze vorks !

1st Frenchman: How many 'ands 'as zis vatch?

2nd Frenchman: It 'as two 'ands! (*Cries of 'Shame'! 'It's a swindle!' 'Anybody could tell that!' etc. All rise.*)

1st Frenchman: Zis vatch 'as not gone since last year at half-past six—vat ees ze time by zis vatch?

2nd Frenchman: 'Alf-past six! (*Frenchmen bow.*)

1st Frenchman: Vill some leetle sheep please lend me von 'alf-crown! (*Boys smack their pockets and exclaim 'Broke!' 'Stumped!' etc.*) Nobody 'as got von? A penny vill do! (*Boys shake their heads.*) No von 'as got so much? Never mind! I vill lend you von! (*Gives a penny-piece to one boy.*) Don't let me see it! (*To 2nd Frenchman.*) Vat ees ze value of zat penny?

2nd Frenchman: Two sous! It 'as ze head of Queen Victoria on von side, and somesing else on ze ozer! Ze date of ze coin is 1892! (*Frenchmen bow.*)

All: What a swindle! It's his own penny! Let us bonnet the cheats!

14th Boy: I say, boys, are you going to put up with this?

Several (*threateningly*)*:* Certainly not!

Nelson: Come round with the hat, old parley-voo, and see what you'll get!

(*The two Frenchmen step forward, taking 'The Young Squire' between them.*)

1st Frenchman: Leetle sheeps, ve 'ave done our best to amuse you—you 'ave no monnaie—bon soir!

1st and 2nd Frenchmen and 'Young Squire': Bon soir, silly leetle sheeps! (*As they bow low the Frenchmen take off moustache, beard, etc., and appear as Kirby primus and Cummings septimus.*)

All (*astonished*)*:* Kirby! Cummings! You old frauds!

(*Kirby and Cummings laugh heartily at the rest.*)

Nelson: These are your French measles! The Young Squire knew all about this!

5th Boy: Wait till to-morrow, that's all! We'll give you French measles! (*Knocking at the door.*)

Bob Brown: Hush, boys! (*'Mr. Brown!' heard without.*) Hush! There's knocking at the door! (*'Mr. Brown!'*) Turn the key, someone is calling!

Enter a Fourth Form Boy.

Fourth Form Boy: Mr. Brown! Boys! Stop your fun! Something terrible has happened!

Bob Brown: Something terrible! What? Where? Down at the Creek?

Fourth Form Boy: Yes! I hardly know what, but something awful must have occurred, for the boys are running in breathless from the bathing party! As I ran up to tell you, I looked through the window on the staircase and saw someone being carried into the Grammar School on a hurdle!

All (*some rising and stretching forward*)*:* On a hurdle?

Bob Brown: Did you speak to no one? Was any name mentioned?

Fourth Form Boy: The fellows took no heed of me, but rushed straight for the Doctor's room! One name only I heard uttered, and that was, 'Mr. Bainbridge'!

All: Mr. Bainbridge!

Nelson: It's a cowardly shame! I guessed something dreadful would happen! But who's this?

Enter hurriedly, Arthur Hamilton and two other fifth form boys.

Arthur Hamilton: Brown! Boys! All of you! The Doctor says all fun must at once cease! Mr. Bainbridge and George Gutridge are both lying in the Doctor's study in an unconscious condition! A medical man, who is with them, says they are hanging between life and death! We are all to remain here till we receive word to do otherwise!

Bob Brown: What has happened? Is any one drowned? You were one of the bathers, weren't you?

Arthur Hamilton: Yes, we were all three there! No one is actually drowned; but Mr. Bainbridge and George Gutridge have had a narrow escape! You know we left House soon after dinner, each boy carrying with him some food for tea. We were to spend the Half in Bysing Woods, have our tea there, and afterwards make our way to that part of the creek called Castle Coot. Here we were to have a swim, and then walk back to House in the cool of the evening.

Nelson: Was Mr. Bainbridge with you all the time?

1st Fifth Form Boy: Yes, Nelson, and a jollier fellow never breathed!

2nd Fifth Form Boy: He's a bit stern in school, but to-day he was the life of the whole party—wasn't he, Hamilton?

Arthur Hamilton: So much so, that some of us felt downright ashamed of having helped to hatch a conspiracy to give him a fright when we got to the water. However, when there, nothing would induce him to go in. Many of the fellows tried all sorts of tricks, but it was no good. He kept rigidly to the bank, fixed his sharp eyes on the bathers, and was neither to be coaxed nor jeered into moving.

Nelson: How did he get nearly drowned then?

Arthur Hamilton: Why, at last, George Gutridge——

1st Fifth Form Boy: He's always first in any mischief, you know!

2nd ditto: He didn't mean any real harm, mind you!

Arthur Hamilton: At last George Gutridge, looking straight at Mr. Bainbridge, cried out, 'Who's afraid to follow?' and struck out towards the middle of the creek, where it broadens and deepens suddenly before it makes a final rush, as it were, for the sea!

Bob Brown: What did Mr. Bainbridge do?

Arthur Hamilton: He shouted to Gutridge to come back, but it was no use; a spirit of mischief seemed to possess him! A few strokes brought him to the deep water forbidden to the boys. Almost instantly we heard a loud shriek, and those of us on shore saw Gutridge throw up his arms as if seized with cramp! The boys were simply paralysed; but Mr. Bainbridge, with lightning speed, threw off his coat and boots, and shouting, 'Every boy to the bank,' himself plunged into the stream!

Nelson: But he cannot swim six strokes!

1st Fifth Form Boy: Perhaps, till then, he had never really tried!

Arthur Hamilton: At any rate, just as Gutridge was sinking for the second time, he grasped him by the hair; when, to our horror, we saw Gutridge fling his arms round Mr. Bainbridge's neck, and we thought both must go down!

Both Fifth Form Boys: It was awful!

Arthur Hamilton: But, instantly, Mr. Bainbridge shouted, so that even we could hear it, 'Put down your hands, or I'll report you to the Doctor!' His presence of mind, or the quaintness of the order, acted like a charm. Gutridge let fall his arms and allowed himself to be half pushed, half drawn to the opposite bank without a struggle!

William Kirby: What did you boys do?

1st Fifth Form Boy: As soon as we recovered from our fright, a dozen of us swam the narrow part and ran along the shore, but only to find that both master and boy had sunk down exhausted on the very brink of the water.

2nd Fifth Form Boy: I, amongst others, snatched up the clothes, and crossed by the punt kept by the brickmakers some distance higher up the creek! Hamilton and a number of others tried to restore animation, while we two ran the three miles back to town before we could find a doctor.

Bob Brown: What a terrible time, Hamilton, that must have been!

Arthur Hamilton: Yes! and worst of all because we felt ourselves to blame for the disaster. However, the doctor at length arrived, and assured us that life was not extinct; adding, that return of consciousness was, he hoped, only a matter of time.

5th Boy: Thanks, Hamilton! M—— (*mentioning Fourth Form Boy*) has told us how the party arrived home. I feel downright ashamed of myself for having said a word against Mr. Bainbridge. Do you mind going to the study to see what progress they are making?

Arthur Hamilton: Certainly, I think I may venture now!

All: There's a good sort, do!

(*Exit Hamilton.*)

5th Boy: I say, don't you think we ought to show Mr. Bainbridge our sorrow for the painful ordeal he is passing through by a round robin, or something of the kind?

All: Yes! Yes! Let's draw up a letter. Now, Bob!

Bob Brown: Stay! Here's Hamilton back! Hear what he says!

(*Re-enter Arthur Hamilton.*)

Arthur Hamilton: Hurrah, boys! Here's good news! As I arrived, Mr. Bainbridge was just dictating this note to Doctor Daymond. (*Reads*). 'Dear Brown and boys, I am sorry my ducking has stopped your festivities, but feast on, for I am quite, or almost myself again, and by the morning I hope to be as right as the proverbial ninepence! Gutridge says he is as sound as a trivet, and joins his wishes to mine that the consumption of tarts and toffee should not cease on our account. Mind, I shall be disappointed if you are not all the merrier for our little mishap and the escape therefrom. Myself, I feel as lively as a kitten, and hope to join the party later on. Don't ask me, however, to drink any healths, for I've taken enough aboard already. Yours sincerely, William Bainbridge.'

All (*looking towards study*)*:* Bravo! Bravo!

Bob Brown (*returning to chair in centre*)*:* Fill your mugs, boys! Never mind—empty ones are as good! Here's long life and happiness to the new Undermaster!

All: Hear, hear!

Nelson: Musical honours! Let it out, so that *he* can hear the little sheeps! Open the door!

(*All stand, look towards study, and sing lustily.*)

For he's a jolly good fellow, (3)
And so say all of us!
With a hip, hip, hip hurrah, (2)
For he's a jolly good fellow, (3)
And so say all of us!
Hurrah! Hurrah! Hurrah!

(*Curtain.*)

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Suitable for 'Unseen Tests' in Reading also.

313.

A Story of the Queen.—Some years ago a party of Eton boys were walking in some fields near the College when they were caught in a drenching shower. They had only one umbrella between them, and the owner of this gallantly gave it up to a lady they encountered who had no protection against the rain. The boys were soaked to the skin when they reached the school; but the proprietor of the umbrella was amply compensated for his courtesy the next day, when a footman from Windsor Castle brought it back with the Queen's compliments, and a handsome present in recognition of the loan.

314.

Story of an Indian.—Years ago matches were not so universally used as now. One day an officer while talking to an Indian took from his pocket a box of what appeared to be mere little sticks, and scratched one on a stone to light his pipe. The Indian eagerly inquired into this mystery, and looked on with astonishment while several matches were lighted to gratify him. He went to his camp and brought back a dozen beautifully-dressed wild-cat skins, which he offered for the wonderful box. The exchange was accepted, and he went off greatly pleased. A little time after, he was found sitting by a large stone, on which he was gravely striking match after match, and did not cease until every one was burned.

315.

Fair Play.—A gentleman one evening walking through Covent-garden, observed two fellows upon the ground, and one of them, who was an Irishman, with his knee upon the other's breast, most unmercifully belabouring him on the face, until he had nearly reduced it to a mummy. The gentleman humanely interfered, and entreated the conqueror to give his opponent fair play, and let him get up and have an equal chance. 'Faith, master,' replied the fellow, turning up his face with a very significant look; 'if you had been at as much trouble to get him down as I have, you would not be for letting him get up so readily.'

316.

The Irishman and the Sovereign.—An Irishman found a sovereign in the street, which proved to be a light one, and he could only obtain 19s. 3d. for it. Soon after, chance threw another in his way, but Pat exclaimed:—'By the powers, I'll have nothing to do with you, for I lost 9d. by the last one I found.'

317.

Sat Upon.—A man who owned a tame bear said that for a long time he could not account for the mysterious way in which his poultry disappeared. Observing at different times a good many feathers around Bruin's pole, he suspected that the bear was the culprit. Close watching confirmed his suspicions. When Bruin thought he was unobserved, he would seize any unfortunate hen or chicken within his reach and devour it; but if anyone approached before he could complete the meal, he would sit upon his prey until the danger of discovery had passed. He was betrayed at last by the cackling of an old hen that his pressure had failed to silence.

318.

Ingenious.—One afternoon, as a day-school class was having lessons, one of the boys, for some slight offence, was called out by the teacher, who told him to go and see the headmaster—as the teachers themselves were not allowed to use the cane. The boy went, and was out about half-an-hour. When he came back, he was rubbing that part of his body to which the cane is generally applied, and looking very rueful indeed. The teacher asked him if he had seen the headmaster, and the boy said 'Yes'; but on being asked the next minute if the headmaster had seen him, he promptly replied 'No.' The teacher was so amused that he did not send the boy out again, and he quickly sat down.

319.

Hunted by a Hare.—An enthusiastic sportsman went to a breakfast given at the commencement of the shooting season. The conversation naturally was of game, when suddenly in rushed a servant, exclaiming to the host that a hare had been seen moving about the lawn. Out ran the enthusiastic sportsman, gun in hand, fired at the hare, and missed it. The hare scratched its nose, then stood on its hind-legs, presented a pistol at the sportsman, and fired in return. No one was hurt, but the sportsman was naturally astounded to have the tables turned in this unexpected and surprising manner. It was explained to him, and then his laugh was as hearty as anyone's. This remarkable hare was a performing animal, which had been hired from a neighbouring show. The sportsman's charge had, of course, been tampered with by the confidential servant.

320.

His Duty.—During the siege of Gibraltar the governor, General Elliott, was one day making a tour of inspection, when he came upon a German soldier who, though standing at his post, neither presented arms nor even held his musket. 'Don't you know me, sentinel?' inquired the general. 'How is it that you neglect your duty?' 'I know you well, general, and my duty also,' was the reply; 'but within the last few minutes two of the fingers of my right hand have been shot off, and I am unable to hold my musket.' 'Why don't you go and have them bound up?' 'Because in Germany a man is forbidden to quit his post until he is relieved by another.' The general instantly dismounted. 'Now, my friend,' said he, 'give me your musket, and I will relieve you. Go and have your wounds dressed.' The soldier obeyed, but went first to the nearest guard-house, where he reported that the general was standing on duty in his place. His injury unfitted him for active service, but the story of his courage soon reached England, and he was made an officer.

321.

He Drank it.—On their arrival at New Zealand, a party of tourists drank the health of the vessel which had brought them safely to their destination. One of the gentlemen who was asked to join in this ceremony, replied: 'No, I'm a teetotaler; but I'll willingly drink success to the ship in the liquor she floats in.' A friend disappeared and returned with a glass of water. The recipient tossed it off at once, but immediately sputtered, 'Ugh—ah—oh—this is—oh—what—what on earth is this?' 'That!' exclaimed his friend; why, you drank success to our noble ship in the liquor she floats in.'

322.

The Dog and the Crows.—A dog was once eating a piece of meat in the presence of several crows. They evidently said a good deal to each other on the subject, and now and then one or two of them tried to pull the meat away from him, which he resented. At last a big, strong crow succeeded in tearing off a piece, with which he returned to the tree where the others were congregated, and, after much earnest speech, they all surrounded the dog, and the leading bird dexterously dropped the small piece of meat within reach of his mouth, when he immediately snapped at it, letting go the big piece unwisely for a second, on which two of the crows flew away with it to the tree, and, with much fluttering and hilarity, they all ate—or, rather, gorged—it. The deceived dog looked vacant and bewildered for a moment, after which he sat under the tree and barked at them furiously.

323.

He Loved Biscuits.—A true story of a farmer's dog, who has been found guilty of obtaining goods under false pretences, has recently been told. The animal is extremely fond of biscuits, and has been taught by his owner to go after them for himself, carrying a written order in his mouth. Day after day he appeared at the chandler's shop, bringing his master's order, and by-and-by the shopman became careless about reading the document. Finally, when settlement day came, the farmer complained that he was charged with more biscuits than he had ordered. The chandler was surprised, and the next time the dog came in with a slip of paper between his teeth he took the trouble to look at it. The paper was blank, and further investigations showed that, whenever the dog felt a craving for a biscuit, he looked round for a piece of paper and trotted off to the shop. The farmer is something out of pocket, but he squares the account by boasting of his dog's intelligence.

324.

An Editor's Blunder.—The editor of a weekly journal lately lost two of his subscribers through accidentally departing from the

beaten track in his answers to correspondents. The two wrote to ask him his remedy for their respective troubles. No. 1, a happy mother, wrote to inquire the best way to get her children fairly over their teething, and No. 2 wanted to know how to protect his orchards from the myriads of grasshoppers. The editor framed his answers on the usual lines, but transposed the names with the result that No. 1, with the children, read in reply to her query, 'Cover them carefully with straw and set fire to them, and the little pests, after jumping about in the flames a few minutes, will be speedily settled;' while No. 2, plagued with grasshoppers, was told to 'Give a little castor oil, and rub their gums gently with a bone.'

325.

A Story of Stanley.—Mr. H. M. Stanley once had a very unpleasant experience, from which he was extricated by his readiness of resource. He was travelling in Africa, and had to put up at a native village, when some of the natives noticed that he was making some entries in his note book, and promptly spread the report that they were being bewitched. A crowd of about five hundred savages then collected, and threatened the explorer with instant death unless the note book was destroyed. Stanley was, of course, very unwilling to give up the notes which he had been at so much pains to collect; he was also somewhat reluctant about losing his life. Suddenly a bright idea struck him, and he offered the bewitched natives a copy of Shakespeare, which they at once accepted as the obnoxious volume, and burnt to ashes amid much rejoicing.

326.

A Noble Boy.—Daniel Bonnet was a weaver two hundred years ago in a French village. He and his wife were Huguenots, and they talked incessantly to their three little children of the glory of holding by their faith, and, if needs were, of dying for it. The troops were sent into the village to convert the Huguenots at the sword's point, and Bonnet and his wife attempted to escape to the coast. They loaded a donkey with vegetables as if for the market, but hid the three little ones in the panniers, charging them, as they valued their religion, to keep silent, no matter what happened. Bonnet, with a basket of turnips, trudged ahead; his wife drove the donkey. Just outside the village they met a trooper. 'Going to market?' he said, suspiciously. 'Then I can try if your carrots be tender!' He plunged his sword into the pannier and waited, but not a sound was heard. The wretched parents had to wait until he was out of sight before they could open the basket. Their boy, a child of five, had been stabbed through the thigh. 'But I did not speak, mother!' he cried. The Bonnets escaped to America, and the blood of the brave lad still runs in the veins of good men and women.

327.

A Useful Umbrella.—The use of the umbrella in encounters with mad bulls is an old story, but the late Bishop Hannington certainly found one useful with even more formidable foes. He was travelling in Africa with some natives when he came across a lion's cub and commenced to fondle it. Directly the natives saw what he was doing they ran away in terror, and a moment later the Bishop noticed a lion and lioness approaching him. He instantly opened the umbrella and flourished it in the faces of the enraged beasts, at the same time dancing in such an extraordinary manner and making such fearful noises that they abandoned their whelp and fled into the heart of the forest.

328.

In Search of Himself.—Some boys, bathing in a swimming bath, reported to the manager that a man had been seen to go down the steps into the water, and that he had not come up again. All the attendants were at once summoned to the spot, and several expert swimmers took part in the search. The whole floor of the bath was carefully gone over, but no trace of a body could be found. The most active member of the searching-party was a young fellow who was an excellent diver, and at last it turned out that he had been in search of himself. He had plunged into the water near the steps, and emerged, as was his custom, at the other end of the bath, unperceived by the boys who saw him enter the water, and who supposed that he was lying drowned at the bottom of the pool.

329.

Accommodating the Engine-Driver.—During the great strike of the railway men a few years ago, the officials of the North British Railway Company experienced much difficulty in finding qualified engine-drivers to maintain the necessary train service. Upon one occasion a young fellow was put upon a section in Fife. One day he ran some distance past a certain station, and, upon putting back, he went as far the other way. The station master, eeing him preparing for another attempt, to the great amusement of the passengers on the platform, shouted:—'Just stop where you are, Sandy; we'll shift the station!'

330.

The Fly's Gratitude.—Once while a man was eating his breakfast on a summer morning, he saw a fly stuck fast in the butter. His first idea was to let it die by the point of his knife, but being in the main a kind-hearted man, better thoughts came to him, and he decided to save its life. So this kind, good man tenderly removed the fly, gently scraped the butter off its little legs; carefully wiped its wings with his table-napkin, and softly stroking its little back, set it at liberty. That night the fly woke him. There was a burglar! He was just putting the last of the family silver into his basket preparatory to carrying it away; but when he saw the owner he dropped his plunder and fled through the open window. The fly, which had followed the man downstairs, buzzed triumphantly over the basket, and then settled confidingly upon his hand. And, looking at it closely, the man, by a certain shiny look that lingered yet about its body, saw that it was the same fly that he had rescued from the butter. He had spared its life, and in gratitude it had saved his silver. Thus we see that kind actions rarely go unrewarded.

331.

The Puzzled Servant.—Some years ago a lady engaged a domestic servant from the Highlands. In the evening the lady wanted supper brought in, so she rang. Not getting an answer, she repeated the summons, but with the same effect. She then proceeded to the kitchen, where, to her amazement, she found the servant almost convulsed with laughter. She pointed to the bell and exclaimed:—'As sure as I live I never touched it, and it's wagging yet!'

332.

The Indian and the Sugar.—Some years ago an Indian came to Fort Sedgwick, having in his possession a very fine and elaborately-painted buffalo robe. Many efforts were made by the officers to purchase that robe; money, sugar, coffee, flour to the value of twenty dollars—all were offered and refused. Some time after a sergeant passed who had in his hand a paper containing two or three pounds of white loaf sugar, cut into cubes, then new to frontier people and to Indians. He gave the Indian a few lumps and passed on. In a few moments the Indian came running after him, took the robe from his shoulders, and offered it for the paper of sugar. The exchange having been made, he sat down on the ground, and deliberately ate up every lump.

333.

Expensive.—A lady was very solicitous about her health. Every trifle made her uneasy, and the doctor was called immediately. The doctor was a skilful man, and consequently had a large practice. It was very disagreeable to him to be so often called away from his other cases for nothing, and he resolved to take an opportunity of letting the lady see this. One day the lady observed a red spot on her hand, and at once sent for the doctor. He came, looked at her hand, and said—'You did well to send for me early.' The lady looked alarmed, and asked—'Is it dangerous, then?' 'Certainly not,' replied the doctor. 'To-morrow the spot would have disappeared, and I should have lost my fee for this visit.'

NEW READING TESTS.—Standard III.

Suitable for 'Unseen Tests' in Dictation also.

242.—A man with one eye laid a wager with another man that he (the one-eyed person) saw more than the other. The wager was accepted. 'You have lost,' says the first, 'I can see two eyes in your face, and you can see only one in mine.'

243.—'My charge for taking out a tooth, madam, is three shillings.' 'But, doctor, isn't that rather dear? Other dentists only ask one.' 'Ah, but you must remember, ma'am, they hurry over their work, while sometimes I spend an hour or so drawing a tooth. I must charge for my time, you know.'

244.—Two very honest fellows who dealt in brooms, meeting in the street, one of them asked the other how he could

afford to undersell him. 'Because,' said he, 'I steal the stuff with which I make them.' 'Why, you foolish fellow,' replied the other, 'I steal them ready made.'

245.—A naughty boy placed a big apple on the front steps and went across the street to see who would take it. A gentleman, who had observed the action, said: 'You shouldn't do that, some poor boy may be tempted to steal it.' 'That's what I'm waiting for, sir. I've hollowed out the inside, and filled it with mustard.'

246.—An Irish footman, who got a situation at the west end of London, on entering a room where there was a vase with golden fish, exclaimed, 'Well,——this is the first time I ever saw red herrings alive!'

247.—Freddie was sawing away at his meat in the house of a schoolmate upon whose cellar-door he had been playing, and whose mother had invited him to dinner. 'Can't you cut your meat, Freddie?' she asked anxiously. 'Yes,' replied Freddie manfully. 'I've cut meat almost as tough as this at home.'

248.—A soldier had his thigh smashed by a fragment of shell. 'Well, my poor fellow,' said his captain who visited him in the hospital, 'you must find it pretty lonesome work being laid up here!' 'Oh no, captain, not at all,' was the reply. 'I suffer a good deal, and that makes the time slip by.'

249.—Tom and Tabby, it need not be said, were two cats. Tom was the more active and stronger, and was also remarkable for being completely white. One day they went out on the house-top to play, and Tom, during his antics, jumped with ease and grace on to the roof of the next house. It was no doubt a splendid leap, taken with great confidence.—(H.M.I.'s Test.)

250.—Kind words are little sunbeams
That sparkle as they fall;
And loving smiles are sunbeams—
A light of joy to all.
In sorrow's eye they dry the tear
And bring the fainting heart good cheer.

NEW DICTATION TESTS.—STANDARD IV.

Suitable for 'Unseen Tests' in Reading also.

No. 194.

PEACEFULNESS, plenty, prosperity, make up the lot of the Japanese people; and it is to be hoped that European civilisation will do no harm to this ingenious, child-like nation, although it is suggested that the Japs are just now at the stage which proves the general truth of the adage, 'A little knowledge is a dangerous thing.' Some people think they are at present too conceited, and that a thrashing at the hands of China would do them good.

No. 195.

ROBBERS are tried and convicted by ballot in some parts of Japan. Whenever a robbery is committed, the ruler of the hamlet summons the entire male population and requests them to write on a slip of paper the name of the person they suspect as having committed the crime. The one receiving the largest number of ballots is declared duly 'elected,' and is accordingly hanged.

No. 196.

BETWEEN the mountains of India and Persia is a powerful tribe among whom an extraordinary custom prevails. Women's rights apparently have received full recognition, for the ladies of the tribe can choose their own husbands. All a single woman has to do when she wishes to change her state is to send a servant to pin a handkerchief to the hat of the man on whom her fancy lights, and he is obliged to marry her, unless he can show he is too poor to purchase her at the price her father requires.

No. 197.

THE silk of the great spider of Madagascar is used by the natives for fastening flowers on sunshades and for other purposes. The thread has a golden colour, is very strong and elastic, and a single female has spun nearly two miles of it in twenty-seven days. The natives weave small fabrics of the thread, and it is thought that an important industry might be raised from it by cultivation.

No. 198.

THE King of Italy is deservedly popular with his subjects. He has frequently been known to stop his carriage in order to attend to peasants who, through illness or the heat, have sunk down exhausted by the roadside. During the cholera epidemic he went in and out quite fearlessly among the people, trying to relieve their sufferings.

No. 199.

No black roses have been obtained, but there are roses of so dark a purple as under certain circumstances to be taken for black. These are extremely rare. In our opinion no flower has a fixed and immutable colour; changes, more or less perceptible, may in every case be made by cultivation. Arabic writers of the twelfth century speak of blue roses as then in existence, and we see no reason to doubt that such was the case, and that similar ones may again be obtained.

No. 200.

THE national colours of England are red, white, and blue; these are displayed on the Union Jack; red, yellow, and blue on the Royal Standard. The national colours of France are also blue, white, and red, arranged perpendicularly in this order from the staff. The Turkish colours are red, yellow, and blue displayed thus: a red ground with a blue rounded oval in the centre, in which are three yellow crescents.

No. 201.

AN electric cane has been invented abroad. It will doubtless be useful to people who have occasion to be out late in the dangerous parts of big cities. By merely touching an assailant it will be possible to give him a shock which will be of great value as a means of self-defence.

No. 202.

IN Syria, people never take off their caps or turbans when entering the house or visiting a friend, but they always leave their shoes at the door. There are no mats or scrapers outside, and the floors inside are covered with expensive rugs, which, in Moslem houses, are kept very clean, and used to kneel upon while saying prayers.

No. 203.

A GENTLEMAN recently hit upon a rather novel expedient for keeping his garden free from the depredations of birds. He placed a stuffed fox in the middle of his vegetable beds, and no fewer than three stuffed cats occupied prominent positions among the branches of his cherry trees. His garden enjoys a singular immunity from the visits of winged robbers.

No. 204.

THE routine of daily life aboard the training-ship must needs vary according to the season of year, the character of the vessel, and other circumstances. Yet it may be taken as a fairly general rule that one-half of the day is devoted to learning the trade of the fighting mariner, and the other half to ordinary and religious education. There is constant variety in whatever the sailor boy is told off to do, and the dietary being of a most liberal order, the best of spirits and muscle can always be kept up.

No. 205.

IT is a pretty well-known fact that most of the deaths that occur on the field of battle result from bleeding to death before surgical aid arrives. The French Government have under consideration a scheme for tattooing the soldiers of the French Army with a certain mark over each artery, so that a wounded man would be able to staunch the flow of blood himself, and thus increase his chance of living.

No. 206.

THE Princess of Wales has a favourite cockatoo, which has been an inmate of her dressing-room for fifteen or twenty years. The bird is white, with a salmon-coloured crest; but it obstinately refuses to wear feathers during the hot weather, and plucks each one out as soon as it makes its appearance, leaving only a few on the head, neck, and tail.

No. 207.

CANTON, with its million inhabitants, is a queer place. The huge wall surrounding it, fifteen to twenty-five feet wide, is six miles in circuit, the whole being filled up with a maze of narrow lanes. The place is full of temples; and every street has an altar. Some 300,000 of the inhabitants live in boats.

No. 208.

QUEEN VICTORIA'S conservative fondness for the things she is used to is shown in the fact that the little ivory paper-knife with which to this day she cuts the pages of her new books was in her possession when she was a little princess. The cabins of Her Majesty's royal yacht are still brightened with the same old-fashioned rosebud chintz which the Prince Consort loved.

No. 209.

THAT pest of the Australian farmer, the rabbit, may yet prove a source of advantage to the colonies. The agriculturists of New South Wales appear to be much cheered by the high prices realised in London by rabbits recently sent there in a frozen state. It is believed that by the aid of rabbit-proof netting an inexpensive mode of trapping on a large scale might be introduced, which, if supplemented by the best methods of preparing for export, would enable the colony to secure a large and profitable trade.

No. 210.

THERE seems to be no doubt that the umbrella was first introduced into Italy from the East, and thence found its way into Europe. The applicability of the instrument as a defence from rain was quite an after-thought, and it was originally, as in the East, only used to protect the person from the rays of the sun.

No. 211.

THE climate of Japan is very much like our own, yet the natives manage to rear plants in the open air which are never seen growing in England. As in Mexico, a passion for flowers absorbs the natives. Giant camellias are planted everywhere; the markets and streets are in a flame of colour all the year round with the splendid bouquets; and as the method of arranging flowers in artistic fashions forms part of every Japanese lady's education, the houses and shops are made gay from January to December.

No. 212.

AMONG Queen Victoria's most cherished possessions are three bracelets. In these are mounted thirty-three miniatures of her grandchildren, taken in infancy or early youth. Each picture is set in a narrow frame of gold, and the settings are adorned with pearls and coral. One of the most interesting portraits is that of the Queen holding Prince Alexander of Battenberg.

No. 213.

THOU art no lingerer in monarch's hall—
A joy thou art, and a wealth to all!
A bearer of hope unto land and sea—
Sunbeam! what gift hath the world like thee?
Sunbeam of summer! oh, what is like thee?
Hope of the wilderness, joy of the sea!—
One thing is like thee to mortals given,
The faith touching all things with hues of heaven!

STANDARDS V.—VII., AND 1ST & 2ND YEAR P.T'S.

No. 180.

A SCOTSMAN has invented a thread-spinning apparatus, and is said to have trained two mice to work it. The mechanical principle of the contrivance is a small mill which is operated by the paws of the mice. They can each wind on and off from 100 to 120 pieces of thread per day, and to do this they must supply a motor power by which a course of 10½ miles could be traversed. It is asserted that the mice perform this task daily without apparent fatigue, and that a half-pennyworth of flour furnishes them with food enough for five weeks. During that time the little animals have spun about 3,850 threads each, a yard-and-a-half in length.

No. 181.

IN the back streets of most of the towns in Holland, there may be seen houses with this curious signboard (in Dutch, of course), 'Here they Knock and Wake Persons'; for in the large, comfortable Dutch beds folk are apt to oversleep themselves, and so the men and women who have to rise very early for their work pay a man a small sum every week to wake them at daybreak. And call them he does, for he knocks and rings until his customers appear at their windows, and the noise he makes is often enough to disturb the whole street. In summer, when the careful Dutch housewife has taken the stove out of the rooms, the waker-up earns a little extra pay by supplying hot water for an early cup of tea or coffee.

No. 182.

IT is not often that a woman is able to array herself in any fabric which three hundred years ago was the property of a Queen of England. The Countess of Pembroke had, however, this proud privilege at the last Drawing Room, when her magnificent white and silver gown and light peach velvet train were trimmed with old point lace which had once belonged to and had been worn by Queen Elizabeth. It was in admirable preservation, and consisted of deep flounces partly of floral designs, and also displaying a terrace walk with birds on pedestals—quaint and curious.

No. 183.

EVERY dish used in a public restaurant of Paris, either in the kitchen or for the table; every pot, pan, and utensil in the bakeries; and every beer utensil in the wineshop—in short, everything used in preparing or serving foods is under the care of an inspector. The law forbids the use of lead, zinc, and galvanised iron in the manufacture of cooking vessels. It orders that all copper vessels be tinned and kept in good condition. It directs that pottery which is covered with a glaze containing enough oxide of lead to yield to a feeble acid be seized. It orders that tin cans must never be soldered on the inside, and that the materials used in their manufacture be conformed to a certain standard. It is the inspector's business to look after all these things, and to see that everything required by the law is carried out.

No. 184.

THE birthplace of icebergs is on the coasts of Greenland. The whole interior of this continent is covered by an immense ice-cap, many hundred feet in thickness. The sun's rays, falling on the snow at the summits of the mountains, partially melt it into a granular mass. The valleys receive the drainage from these granular snow-fields, and the cold converts it into a solid mass of ice—a glacier. This icy stream is driven constantly onward toward the coast, which it lines with an enormous crystal precipice.

No. 185.

THE Italian Premier's temperament is of a nervous excitable kind, and he brooks no opposition. That his intelligence is of a high order is conceded by all who really know him. He has naturally rare capabilities, and his mind has been broadened and stored with that knowledge not contained between the covers of books, by his travels, and through contact with the eminent and obscure alike. He is a scholar of diplomacy, and has the caution and shrewdness of a well-seasoned conspirator, and the ready use of his wits that has come to him in the exigencies of numberless political combats.

No. 186.

IN the majority of persons the right hand is more sensitive to touch and less sensitive to temperature than the left. If the two hands be dipped in two basins of water of the same temperature, the left hand will feel the greater sensation of warmth; it will do this even when thermometers show that the water in the left basin is really somewhat colder than that in the right. These effects are no doubt owing to the fact that more constant use has a tendency to make the skin of the right hand thicker than that of the left. They are, of course, reversed in the case of left-handed persons.

No. 187.

THE present method of tinning fish, flesh, fowl, and everything else that is edible, was suggested to two wide-awake Yankees, who chanced to discover, in the ruins of Pompeii, a number of jars of preserved figs. They were tried, and found to be in excellent condition, and further examination showed that the fruit had been placed in the jars in a heated state—an aperture being left for the steam to escape—and finally sealed down with wax. So now, when we eat tinned salmon, apricots, lobsters, or tomatoes, we are simply profiting by the experience of people who existed nearly twenty centuries ago.

No. 188.

IN Manchester there is a corps of Cadet Volunteers. The corps consists of lads between the ages of fourteen and seventeen, who, on joining, have to pay a subscription of sixpence a week until they have paid ten shillings towards their expenses whilst in the corps. The regiment is now ten years old, and has four hundred members. They are officially recognised by the War Office, and form part of the Volunteer forces of the Empire. They are the youngest defenders of Great Britain and Ireland. A great event of the year which the cadets look forward to is the annual encampment. This year it was at St. Anne's. The camp, which is carried on in the same way as the Volunteers', has to be guarded day and night all the week. There are three parades a day in camp, so that it is not all play.

No. 189.

THE well-known love of seals for musical sounds too often leads to their destruction. When the Eskimo hunter sees none of his prey about, he begins whistling, and sooner or later is sure to attract an appreciative seal within the reach of his harpoon. Lying at full length at the edge of the ice, he continues whistling low, plaintive, calling notes, and presently a few of the animals will draw near to the spot, lifting themselves as high as they can out of the water, and slowly shaking their heads to and fro, as if keeping time to the music. By-and-by one seal, more daring than its fellows, will come very close to the hunter, who then jumps to his feet and slays the creature, while its mates make off as quickly as possible.

No. 190.

ONE peculiarity of pearls is that, unlike other precious gems, they are liable to decay. Occasionally a valuable pearl changes colour, seems to be attacked with a deadly disease, and crumbles into dust. Such is reputed to have been the fate of the most magnificent specimen ever known. Passing through successive hands, it finally became the property of a Russian millionaire. He kept it hidden for a time, but at last consented to show it to some distinguished lovers of precious stones. But when he opened the casket he fell back in dismay, and staggered as though stricken with death. The gem had begun to change colour. A fatal disease had attacked it. It was soon a worthless heap of white powder.

No. 191.

A RATHER curious story, which may or may not be true, is told of the War Department. Some time since, it is said, a workman was engaged in casting metal for the manufacture of ordnance at Woolwich Arsenal, when he lost his balance and fell into a huge cauldron containing twelve tons of molten steel. The metal was at white heat, and of course the unfortunate man was utterly consumed in less time than it has taken to tell it. The War Department authorities held a conference and decided not to profane the dead by using the steel in the manufacture of ordnance, and that enormous mass of metal was actually interred, and a Church of England clergyman read the services for the dead over it.

No. 192.

THE University Press at Oxford is probably the most remarkable printing establishment in the world, as well as one of the oldest. It is what may be called self-contained, and if everything else pertaining to the art of printing were blotted off the face of the earth to-morrow, the University Press would go on as if nothing had happened. It makes its own type and its own ink; burns its own charcoal for making the ink, makes its own paper and so on. The workmen in the Press are as interesting as the establishment itself. In many instances, son has succeeded father down the centuries in its employ.

No. 193.

IF the companies adopt the latest invention for their carriages, it will go towards removing or overcoming any feeling of discomfort, and enable passengers to enjoy the ever-varying view of the country passed through. This invention provides a map on the side of the carriage, on which the route travelled is lined in heavy black. As the train moves, a pointer travels over the map, so that passengers may see for themselves exactly in what part of the country they happen to be. Wayside stopping places, as well as the more important towns, are marked, while the names of places considered specially worthy of notice are given in red letters.

No. 194.

THE Swiss Telephone Service, now under Government control, is said to be the best and cheapest in Europe. The Government allows eight hundred calls a year to each subscriber, without extra charge; and all calls beyond that number are charged for at one halfpenny each. The usual charge to subscribers is five pounds for the first year, four pounds for the second year, and less than three pounds per year from then onwards. Telegrams are received at the telephone office, and delivered to the telegraph department at a penny each.

No. 195.

IN Lancashire the coal-mines are very extensive, half the county being undermined, and many years ago the managers of an important colliery thought they could save money by transporting the coal underground instead of on the surface. So a canal was constructed and the mines drained at the same time. Ordinary canal boats are used, but the power is furnished by men, and the method of propulsion is unique. On the roof of the tunnel are placed cross-pieces at regular intervals. The men lie on their backs upon the loads of coal and push with their feet against the cross-bars on the roof, and thus they move forward the barges.

No. 196.

How sleep the Brave, who sink to rest
By all their Country's wishes blest?
When Spring, with dewy fingers cold,
Returns to deck their hallow'd mould,
She there shall dress a sweeter sod
Than Fancy's feet have ever trod!
By fairy hands their knell is rung,
By forms unseen their dirge is sung;
There Honour comes—a pilgrim grey—
To bless the turf that wraps their clay;
And Freedom shall awhile repair
To dwell—a weeping hermit—there!

COMPOSITION TESTS.—STANDARDS VI. & VII. AND 1ST & 2ND YEAR P.T.'S.

Write at least 20 lines on ONE of the following:

42. Say what you know about a Spider, its habits, etc., *or* any pet animals you have at home; OR

43. In a letter applying for a situation as an apprentice to some trade or occupation, give your reasons why you think you will like this occupation; OR

44. Write what you can about Kindness to Animals.

45. Say what you know about a Hen and her Chickens, their kind, covering, appearance, the mother's care and instinct, etc.; OR

46. Write a letter for a situation as errand boy, or nursemaid to two little girls; OR

47. Say what you know about an Orange, its appearance, where grown, how gathered, any peculiarities about it, uses, etc.; OR

48. In a letter to your Mother describe the contents of one of the Reading Books you use in your class; OR

49. Write all you can about Love and Obedience to your Parents and Teachers, the necessity, benefits arising, happiness to be gained 'When there's love at home.'

50. Say what you know about a Shilling, shape, words, figures, image on it, value, uses, etc.; OR

51. Write a letter thanking your Teacher for any prize you have gained and for the kindness and attention you have received during your school career; OR

52. Say what you can about a Rose, the kinds, size, properties, uses of flowers and leaves, etc.; OR

53. In a letter to your Cousin tell her how children may show their love to one another, *or* about the old proverb, 'Where there's a will there's a way'; OR

54. Write all you can about Good Manners, their importance, etc., why they should be acquired and practised.

SONGS BY RECOGNISED COMPOSERS.—Mr. Spencer Curwen addressed the following letter to the Rt. Hon. A. H. D. Acland, M.P., on March 25th. He has merely received a formal acknowledgment, but the general impression is that the new 'instruction' is not likely to be enforced, and may be withdrawn next year:—

(*Copy.*)

'May I take the liberty of pointing out that an expression in the Revised Instructions to H.M. Inspectors that the school songs should be by "recognised composers," will seriously perplex the friends of school music, and cause, I fear, the introduction of unsuitable music in the schools? The phrase "recognised composers," will be interpreted in many ways. Composers of the first rank have written scarcely anything that is fit for schools. Either in words, compass, or phrasing, nearly all their music is out of court. Again, we are told by Prof. Stanford and others, that Folk-songs are what schools should use. These Folk-songs are by nobody knows whom: their composers are unknown, and if known would not be "recognised." The source of many of our National "Patriotic" songs is also unknown. Again, I have constant evidence that in the ranks of the elementary teachers in the service of your department, there are many capable of composing both words and music of school songs in charming taste and complete suitability to children. Yet these composers are not "recognised." I have not had the opportunity of speaking to any friends about this new instruction, but I hear that already it has caused a scare among the teachers, and set them searching for music which is not likely to suit the children. If you are able in any way to allay this excitement, or enable me to do so, I shall be very much obliged.'

WELL-KNOWN TEACHERS AT WORK.

XLI.—MR. GEORGE SHARPLES.

Waterloo Road Board School, Manchester.

THE editorial mandate to the effect that Manchester and Mr. George Sharples were to constitute the next item on our programme was hailed by us with no small amount of gratification. The enthusiasm engendered by the never-to-be-forgotten Conference of Easter week was still fresh upon us, and the magnificent hospitality then proffered by the teachers of Cottonopolis made us nothing loth to again improve our acquaintance with them. Accordingly we hied to Manchester, and in due time arrived at the Waterloo Road Board School.

Yours Faithfully
Geo Sharples.

The fact that this establishment is the possession of the Manchester School Board is prominently set forth by means of a large signboard placed upon the walls of the building. In a like manner the visitor is informed that the school is conducted in accordance with the Education Acts of 1870 and subsequent years, and, further, that a Commercial Evening School and Science and Art Evening Classes are held therein. The Waterloo Road School, we afterwards learnt, was opened in September 1889. It is a Mixed school, with over 900 pupils on the books, and the average attendance for the past year reached 757. The building is large and commodious, and is arranged on the class-room principle. Looking down a long corridor we observe a number of class-rooms separated from each other by partitions in which glass is largely used. There is none of the distracting inconvenience which characterises the working of a number of classes in one large room. Each class is entirely to itself, and the whole are at once accessible to the supervision of the principal teacher. At the end of the corridor is situated the master's office. Here we were conducted, and the evergreen welcome of Mr. Sharples greeted us. Explaining the object of our visit, we at once set out upon our tour of inspection. Immediately on entering the corridor we were attracted by the handsome Football Challenge Shield, which is the property of the Manchester and Salford Elementary Schools' Football Association. It is a beautiful work of art. The arms of the city of Manchester and the borough of Salford, together with an artistic view of the field of play, are engraved upon it, while an inscription informs us that the shield is presented for annual competition amongst the elementary schools of Manchester, Salford, and District, and that the funds shall be devoted to the aid of the charities. On one of the spaces left for the names of successful competitors we notice 'Waterloo Road, 1894.'

Passing from one class-room to another, we discover that an uniform style of writing is adopted throughout. On the glass panels in the class-rooms pictures abound. Freehand drawing copies are neatly cut out in paper, and occupy a conspicuous position on the walls. The partitions between the rooms can be raised, thus providing a large room, which possesses the great advantage of allowing each pupil to take his or her proper place in the respective classes while the whole school is assembled. No exercise or copy books are used. The writing is done on paper, and each scholar is provided with a stiff piece of cardboard on which the paper rests. Blackboard lessons are the rule, the teacher showing why the style adopted is the proper one, and thus avoiding the monotony of a stereotyped writing exercise.

A glance at the time table fills us with surprise at the wide range of the curriculum. We opine that a strong 'half-time' element would seriously interfere with the working of such a time table, but happily that element is conspicuous by its absence. The children, on the whole, are of a good class, and, as one may expect from the locality in which the school is situated, a tinge of the Jewish community is noticeable. Mr. Sharples speaks in praiseworthy terms of the punctuality, regularity, and diligence of his Jewish pupils. Geography was being taught in the various classes at the time of our inspection, and from the manner in which the lessons were given, it was obvious that the instruction was in the hands of capable teachers, and that the lessons had been carefully prepared. We had not concluded our visits to the various rooms on this particular floor before the sound of a gong roused our anticipation. This was followed by the reverberation of a lively march throughout the corridor, played upon the pianoforte, and forth from each room, with military precision, issued the children, the girls marching to the left, the boys to the right, and proceeding, by their respective means of exit, to their playgrounds for

recreation. We visited them at play. One of the class teachers is responsible for the supervision of the playground, and one cannot help but admire the spirit which is infused into the boys by the constant contact and connection which exists between them and their teachers outside their studies. When the allotted time for play expired, we had a splendid opportunity of noting the kind of discipline obtained. A shrill whistle from the teacher in charge suspended immediately every game, and brought every lad to the attitude of attention just where he stood. It was a striking scene. The instant change, the look of expectancy on the faces of the scholars, the various groups, and the eyes of every boy directed towards the teacher, all waiting for the command or the observation to be made, combined to present what would have been a 'snap-shot' after the enthusiastic photographer's own heart.

A second whistle was the signal for the 'fall in.' Each class then marched back to its room with the same exactitude as had characterised its egress. The girls were now busy with their needlework. The boys of the lower standards were occupied in reading. One class we noticed engaged in mastering the difficulties of Algebra, and then we proceeded to the lower regions. Here we were introduced to a well-appointed lecture-room. An ample demonstration-table occupied the front of the room, whilst a gallery gradually rose to the rear. The glass cupboards along the wall were well stocked with an abundance of useful, and in many cases very expensive, scientific apparatus. Immediately adjoining the lecture-room is the laboratory. Here a class was at work, putting into practice the theories they had previously been taught. The laboratory is excellently fitted up. Accommodation is provided for forty-eight pupils. On a raised platform at one end is the teacher's demonstration-table, replete with all the necessary apparatus, etc., whilst huge sliding blackboards are covered with illustrations explaining the uses of various apparatus, the mode of conducting experiments, etc. Leaving these not altogether aromatic quarters, we were conducted to the workshop, where a number of boys were receiving manual instruction. The training here given is not on strict 'Sloyd' principles. An attempt is made to be more practical, and to produce work of a more useful character, and from the models which we were shown, we were able to form the judgment that the objects sought are well attained.

The teacher is assisted by a skilled artisan in the practical part of the instruction. The primary object is to teach the pupils the use of tools. The article to be made is first drawn to scale, and afterwards worked out. The sketch of each model is preserved in the scholar's drawing book, and when his series is completed his book and models form a valuable acquisition.

The workshop at Waterloo Road contains thirty-one benches, and is replete with all the necessary tools. At the completion of each lesson the benches are swept with a small brush by their occupants, everything neatly put in its proper place, and the dismissal of the pupils conducted in the orderly manner which is a feature of the school. Regaining the main building, we ascend the steps once more and pay a visit to the cookery-room. Here, in addition to the ordinary range, oven, etc., heated by the fire, is a large gas oven fitted up with the modern improvements.

As we passed from room to room we could not refrain from wondering at the immense amount of resource, tact, and organising capability which is necessary for the efficient conduct of this large establishment. Mr. Sharples speaks highly of his staff, and indeed without a most efficient body of class teachers he would be handicapped indeed. Seven class masters and seven class mistresses, twelve of whom are certificated, constitute the *personnel* of the staff engaged, not to mention the three pupil-teachers. In addition to the permanent staff a specialist is employed to give instruction in book-keeping and shorthand; a special instructress takes charge of cookery, whilst the Board's drill instructor supervises the teaching of military drill.

The Waterloo Road School is one of the practising schools for the Manchester Day Training College. The tone of the whole place is elevating. We have referred to the fine spirit which evidences itself between teachers and scholars. This is none the less marked between the principal teacher and his staff. One of the highest testimonies to the respect and esteem in which Mr. Sharples is held is to be found in the unanimous meed of admiration accorded to him by his class teachers. There is an entire absence of friction of any kind, and the idea which seems to permeate everybody, from the principal down to the

WATERLOO ROAD BOARD SCHOOL, MANCHESTER.—MIXED DEPARTMENT.

TIME TABLE.

DAY.	Standard.	8.50.	8.50—9.0.	9.0—9.50.	9.50—10.0.	10.0—10.50.	10.50—11.0.	11.0—11.30.	11.30—12.0.	12.0.	—	1.50.	2.0.	2.0—2.10.	2.10—2.45.	2.45—3.20.	3.20—3.30.	3.30—4.0.	4.0—4.30.
MONDAY.	Ex. VII., VII.	Assemble in Playground.	Registers Marked in Red Ink.	Singing, Prayer, and Religious Instruction.	Registers Closed.	Arithmetic	Recreation.	Reading	English	Dismissal.	Recess.	Assemble in Playground.	Registers Marked in Red Ink.	Religious Observance.	Geography	French	Recreation.	Mathematics	
	VI. *a*, *b*					Arithmetic		Reading	English						Geography	Composition		*Boys*—Algebra and Arithmetic	
	V. *a*, *b*					Arithmetic		Reading	English						Geography	Composition		*Girls*—Needlework	
	IV. *a*, *b*					Arithmetic		Reading	English						Geography	W. Building			
	III. *a*, *b*					Arithmetic		Reading	English						Geography	W. Building			
	II. *a*, *b*, *c*					Arithmetic		Reading	W. Building						Geography	Tonic-sol-fa			
	I. *a*, *b*					Arithmetic		Reading	W. Building						Geography	Tonic-sol-fa			
TUESDAY.	Ex. VII., VII.					Composition		Drawing	Drawing						Book-keeping	Drill & Ph. Exer.		Shorthand	Shorthand
	VI.					Arithmetic		Drawing	Drawing						Physiology	Drill & Ph. Exer.		Shorthand	Shorthand
	V.					Arithmetic		Drawing	Drawing						English	Drill & Ph. Exer.		Physiology	Phys. (paper)
	IV.					Arithmetic		Drawing	Drawing						English	Drill & Ph. Exer.		Reading	Composition
	III.					Arithmetic		Drawing	Drawing						English	Drill & Ph. Exer.		Reading	Composition
	II.					Arithmetic		Drawing	Drawing						English	Drill & Ph. Exer.		Geography	Writing
	I.					Arithmetic		Drawing	Drawing						English	Drill & Ph Exer.		Geography	Writing
WEDNESDAY.	Ex. VII., VII.					Mathematics		Inorg. Chem.	Theoretical						Geography	Composition		Prac. Geometry	Prac. Geometry
	VI.					Arithmetic		Reading	English						Geography	Composition		Drawing	Drawing
	V.					Arithmetic		Reading	English						Geography	Composition		Drawing	Drawing
	IV.					Arithmetic		Reading	W. Building						Geography	Tonic-sol-fa		Drawing	Drawing
	III.					Arithmetic		Reading	W. Building						Geography	Tonic-sol-fa		Drawing	Drawing
	II.					Arithmetic		Reading	W. Building						Spec. Lesson	Composition		Drawing	Drawing
	I.					Arithmetic		Reading	W. Building						Spec. Lesson	Composition		Drawing	Drawing
THURSDAY.	Ex. VII., VII.					Arithmetic		Reading	English.						French	Tonic-sol-fa		Drawing	Drawing
	VI.					Arithmetic		Reading	Composition						Physiology	Tonic-sol-fa		Drawing	Drawing
	V.					Arithmetic		Reading	Composition						Physiology	Tonic-sol-fa		Drawing	Drawing
	IV.					Arithmetic		Reading	English						Spec. Lesson	Dictation		Drawing	Drawing
	III.					Arithmetic		Reading	English						Spec. Lesson	Dictation		Drawing	Drawing
	II.					Arithmetic		Reading	English						Obj. Lesson	Dictation		Drawing	Drawing
	I.					Arithmetic		Reading	English						Obj. Lesson	Dictation		Drawing	Drawing
FRIDAY.	Ex. VII., VII.					Arithmetic		Inorg. Chem.	Theoretical						Geography	3—4.30.			
	VI.					Arithmetic		Reading	English						Geography				
	V.					Arithmetic		Reading	English						Geography	VII. & Ex. VII.—Practical Inorganic Chemistry.			
	IV.					Arithmetic		Reading	English						Geography	V. and VI. *Boys*—Algebra.			
	III.					Arithmetic		Reading	English						Geography	I.—IV. *Boys*—Reading and Arithmetic.			
	II.					Arithmetic		Reading	Geography						Geography	I.—VII. *Girls*—Needlework.			
	I.					Arithmetic		Reading	Geography						Geography				

Notes.—1. *Practical Cookery*—Taken by the Girls (Stnds. IV., V., VI., VII.) on Wednesday and Friday.
2. *Manual Instruction*—Taken by the Boys (Stnds. V., VI., VII.) daily in the Workshop.
3. *Model and Criticism Lessons.*—Thursday Afternoon. 4. *Penny Bank.*—Open on Monday Morning.
No child is admitted into this School after the Registers are finally closed.

GEO. SHARPLES, Principal Teacher.

Approved on behalf of the Board—W. H. WILSON, Inspector of Board Schools.
Approved on behalf of the Education Department as fulfilling the requirements of Section 7 of the Elementary Education Act, 1870—J. KAY, H.M. Sub-Inspector of Schools.

lowest scholar, is that his or her first duty is to strive for the good reputation of the school. To the college student with average perception abundant opportunities for advancement must display themselves during the period which he spends at Waterloo Road.

It is impossible to give a detailed account of the various branches of instruction which are undertaken. We have neither the space at our disposal nor the opportunity to spend the time in the school which we should desire in order to accomplish that task. It must suffice when we say that our impressions convince us that few schools present such a truly educational curriculum as that in operation at Waterloo Road, and fewer still carry out their methods on as high an educational platform. The experience of Mr. Sharples has been a somewhat varied and an extremely valuable one. He is a Lancashire man by birth, being born at Bolton. He was educated and served his apprenticeship as a pupil-teacher at the Holy Trinity National School in that town. From thence he proceeded to St. John's Training College, Battersea, his years of training being 1875–6. He was a Latin Prizeman in both years, and was one of the twenty prizemen in the country in mathematics, obtaining the Committee of Council's prize in Euclid in 1876. From college he returned to his native town to take charge of All Saints' Church School. After two years of highly successful service he was appointed to the headship of Pikes Lane Board School, Bolton. Taking the supervision of this school in 1879 with an average attendance of 225, he left it 1881 with an average of over 600, and was appointed by the Bolton School Board as Organising Master and Inspector of Board Schools. On February 1st, 1883, he took charge of the most important of the schools belonging to the Huddersfield School Board, namely, the Spring Grove Board School.

The severance of his connection with the Bolton School Board evoked a most enviable display of public opinion.

One of a series of 'Social and Political Sketches,' which appeared in the *Bolton Journal* in December 1882, demonstrates the popularity of Mr. Sharples, as the following extract shows:—

'Every true and wise friend of popular education in the town will learn with deep regret that Mr. Sharples has ceased to be Inspector of Board Schools. His incontestable ability, the thoroughness of his work, and the good results which have followed, make his loss no common one. His tenure of office has been brief, but it has revealed special qualities of a very high order, and it has at least served to suggest, if not to establish beyond cavil, the importance of the work which attaches to such an office, and the great value which such an office, well-filled, is to an educational system.'

Mr. Sharples controlled the Spring Grove Board School for a period of nearly five years. During this time he had as class-masters on his staff, Mr. T. J. Macnamara, the editor of the *Schoolmaster*, and Vice-President of the N.U.T., and Mr. R. Waddington, now of the N.U.T. Executive. The examination at the Spring Grove Board School in 1888 took place two months after Mr. Sharples had left. The Government Report on that examination states:—

'The school is in an excellent state. It promises to maintain in future the praiseworthy discipline and high standard of attainments which were characteristic of it under Mr. Sharples.'

We have before us evidence of a most remarkable character which demonstrates the highly efficient manner in which Mr. Sharples conducted this school. In September 1888 Mr. Sharples was appointed Head Master of the Leeds Central Higher Grade Board School (Boys'). Here he laboured with success for one year only, when he migrated to Manchester and opened his present school. The last report he received here is worth reproduction. It reads as follows:—

'This very large and important school continues to be managed and taught with much intelligence, tact, and success. Discipline and tone are very good. The elementary work is done with very praiseworthy accuracy, neatness, and intelligence. The class subjects, recitation, singing by note, and drill, are all very satisfactory. Needlework is good, and the fifth and sixth standards have passed a very successful examination in algebra and physiology.'

Lying before us at the present time is a small Blue Book published by the School Committee of Douglas, Isle of Man, and it contains the report of a sub-committee as to the advisability or otherwise of establishing a Higher Grade Board School in Douglas. Quoting from this report we find:—

'Mr. G. Sharples, at present Head Master of the Waterloo Road Board Schools, Manchester, and organiser of the evening classes in Manchester opened under the Technical Instruction Act 1890, and formerly Head Master of the Leeds Higher Grade School, came specially to the island, with the permission kindly given of the Manchester School Board, in order to be examined before the Sub-Committee. Mr. Sharples, owing to his almost unrivalled practical experience in the matter of Higher Grade Schools in England, was peculiarly well qualified to inform and advise as to a school for Douglas, and the Committee are to be congratulated upon having secured his services for this purpose.'

We may add that the decisions of the Committee respecting the establishment of the Douglas Higher Grade School are almost entirely based upon the recommendations of Mr. Sharples.

We remarked the fact that Mr. Sharples was connected with the Manchester Evening Schools, and we were informed that the Evening School at Waterloo Road comprises two 'sides'—one devoted to commercial education, and the other to science and art. A large and efficient staff is maintained. The curriculum of the commercial school embraces, in addition to the ordinary subjects, bookkeeping, shorthand, typewriting, French, German, practical cookery, and dressmaking. In the science and art school practical plane and solid geometry, machine construction and drawing, building construction, mathematics (Stages I. and II.), physics, and theoretical and practical chemistry find a place. Both day and evening schools are well equipped with school requisites. A set of sectional models capable of being divided, together with an expensive set of illustrations of descriptive geometry, must be of immense service in the teaching of drawing. A skeleton in its cupboard is another acquisition for the instruction in physiology.

Mr. Sharples is well known throughout the country

because of his connection with the football world. His deeds of prowess in the field have been most numerous. Those of our readers (and they are many) who wax enthusiastic over the Association game may learn with interest something of Mr. Sharples' career in this particular.

He played with his college team, then with the Eagley F.C., afterwards with the famous Bolton Wanderers, of which club he was captain in 1882. He was subsequently connected with the Great Lever F.C., in whose palmy days he had as members of his team Trainer, J. Goodall, A. Jones, D. Hodgetts, T. Green, and T. Buttery. His distinguished services earned him a position in the Lancashire County team. His removal to Huddersfield brought him in contact with the Rugby game, and for a time he officiated for the Huddersfield club. In 1885 he retired from active service, and is now a League referee. Small wonder that Waterloo Road boys love football, and that the Manchester and Salford teachers knew the right man for the secretary of their football association.

In the arena of professional politics Mr. Sharples is not unknown. He has been a member of the N.U.T. since leaving college. In 1887 he was Vice-President, and in 1888 President, of the Huddersfield Association. In 1884–86 he was Treasurer to the West Yorks District Union. In 1893 he was elected Vice-President, and in the following year became President, of the Manchester Association. He is a former member of the Council of the Huddersfield Church Day Schools Association.

But the crowning effort he has made in his labour for the teachers is of recent date. Who can forget his reception at the Easter Conference when he was called upon to respond to the vote of thanks passed to him for his labours as Bazaar Secretary? To no one more than to Mr. Sharples was the raising of Manchester's £4,600 due, and the country's magnificent total of £13,600 represented more energy and determination which had emanated from him than most persons realised.

In social circles also does he bear his part, being Vice-President of the newly-formed Manchester Teachers' Club. He was a candidate at the recent Executive election, and succeeded in securing no less than 3,966 votes. The visitor to his home is struck by the numerous tokens of affection and esteem which he has from time to time received from former pupils and teachers. His splendid powers of organisation, his indomitable energy and remarkable power of will, stamp him as a teacher far above the ordinary pedagogic average; and when we couple with these his valuable experience, we can realise how it is that his career has been so successful. Mr. Sharples believes that boys and girls should be taught together, that attendance at Continuation Schools should be compulsory, and he is strongly in favour of a greater development in the commercial side of education. We concluded our visit to his school with the conviction that the Manchester people could congratulate themselves upon the possession of a splendid educational establishment in Waterloo Road, and that the Manchester School Board had not been lacking in judgment and perception when they secured as its principal the subject of this far too inadequate record.

TEACHERS' DRAWING LESSONS.

MODEL.

Standard VI.

BY E. BUFFERY RIDGE,
Art Master under the London School Board.

Vases.—The difficulties met with in teaching pupils to draw these models are often due to the want of a systematic way of dealing with them. The drawing of a vase should be studied as a new branch of the subject: first, with regard only to the actual shape of the object, as shown by its proportions and curves, and, secondly, in relation to the modifications in these brought about by change of position.

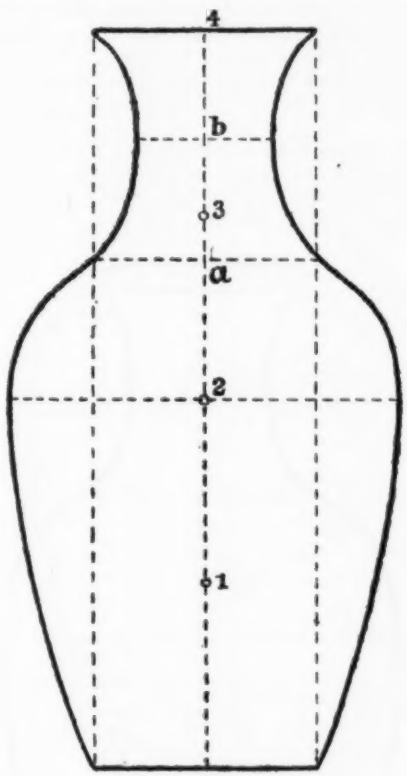


Fig. 1.

I. Prepare a large freehand copy similar to Fig. 1, showing the exact shape of the vase in 'elevation.' The top and bottom are straight lines, and the sides give the profile without alteration. (The figures are one-half full size.) Treat the copy exactly as an exercise in freehand. What are the proportions? The greatest width is *more* than half the height; the bottom and top are *more* than half the greatest width; the neck is *more* than half the width of the top. No exact measurements of one part by another are likely to be found, for the reason that such proportions are not considered by artists and designers as the most beautiful and pleasing.

Divide a centre line into four equal parts, and use it as a scale from which other dimensions can be taken. Half-way up, at 2, or a little above, draw a cross line and mark the greatest width on each side, then the widths of the mouth and base. Draw the vertical lines down from the ends of the top to the bottom. Mark point *b* between 3 and 4, but nearer to 3, and point *a* below 3.

How many changes of direction can be seen in the curving side of the figure? From the bottom to 2 is a long flat curve bending inward, 2 to *a* a sharper curve bending also inward, *a* to the top another curve bending outward. Three curves, occupying spaces already marked out on the drawing, and joining each other tangentially so as to form no break in the smooth run of the side.

Draw cross lines *a* and *b*, marking the widths; draw the neck curve on the left-hand side, then the shoulder curve, lastly the body curve. When they are seen to flow evenly one into the other, draw similar curves on the right-hand side. The corners of the top, or lip, must not be sharp.

This freehand exercise should be repeated till the class can do it readily and well, even from memory.

II. A vase is, like a cylinder or a cone, a solid of revolution, and turning it round makes no difference to its shape. But any change in the angle made by the axis of the model and the line of vision alters

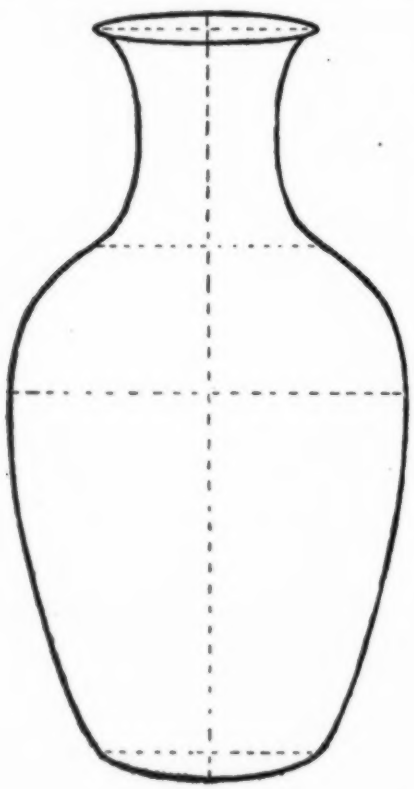


Fig. 2.

the appearance, and, of course, the drawing. Fig. 1 is never actually seen. When the eye is on a level with the lip, the top is straight and the bottom curved downwards; on a level with the bottom the eye would see a straight line there and a curved lip above. With the eye level at the middle, both top and bottom would be curved, and all such curves are representations of circles, and are consequently parts of ellipses.

Fig. 2 shows the same vase as seen from a point a little higher than the top. The centre line is shortened slightly, but the cross lengths are unaltered, and their places on the vertical line are fixed by the same proportions. The opening at the top is seen as a narrow ellipse, *under* the ends of which the neck curves spring downwards. At level *a* the neck and shoulder curves join rather more angularly than in Fig. 1, owing to a larger portion of shoulder being seen when the eye is above it. The bottom is elliptical, slightly more rounded than the top.

The general effect is more roundness and fulness in the curves in Fig. 2 than in Fig. 1, and the more the eye is raised above the object, the greater will this difference be. Compare Fig. 3 with Fig. 2. The

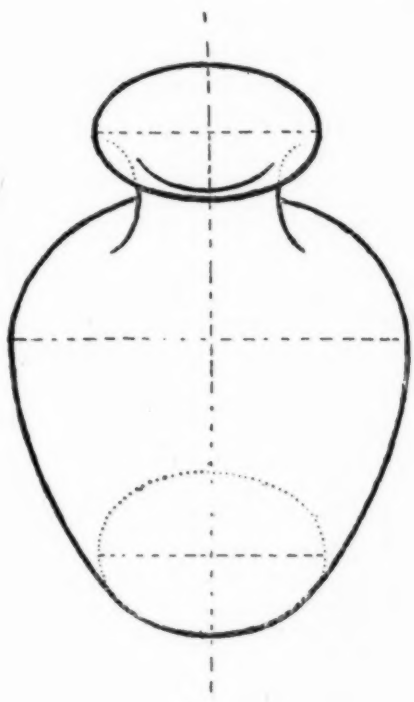


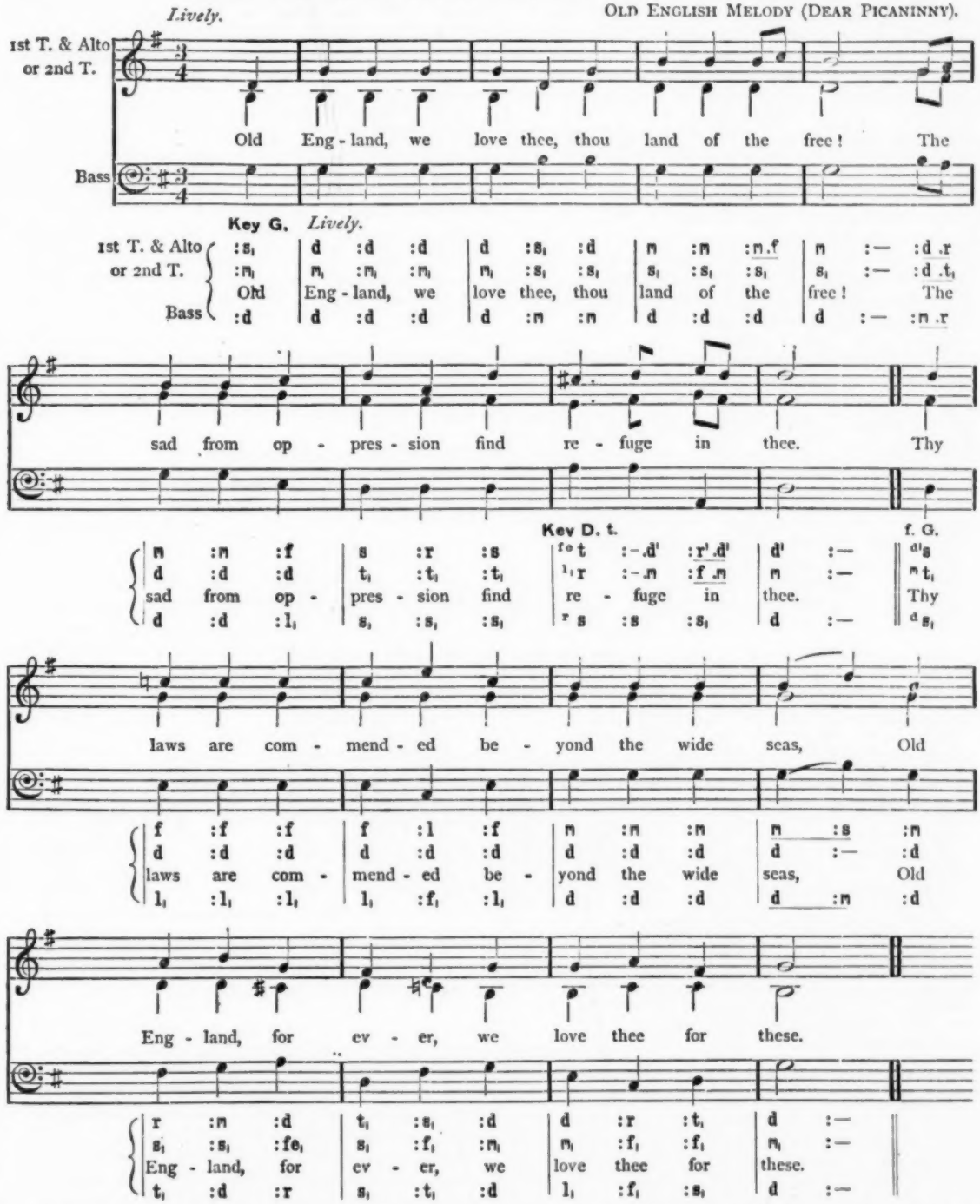
Fig. 3.

vase is much below the eye, the centre line is considerably shortened, yet the cross lines remain the same. The top and bottom ellipses are widened out almost into circles, the lip hides part of the neck, the sides and base seem to form one curve, the shoulders extend back behind the neck, and a small part of the inside of the neck is shown.

This the class will learn better at first from a drawing than from description, of course with the model to refer to.

Fig. 4 shows the vase lying down, the mouth presented towards the right of the observer. The figure is just the same as Fig. 3, and is constructed and

OLD ENGLAND, WE LOVE THEE.

Lively. OLD ENGLISH MELODY (DEAR PICANINNY).

1st T. & Alto or 2nd T.
Bass
Old England, we love thee, thou land of the free! The
Key G. Lively.
Old Eng-land, we love thee, thou land of the free! The
sad from op-pres-sion find re-fuge in thee. Thy
Key D. t. f. G.
sad from op- pres-sion find re-fuge in thee. Thy
laws are com-mend-ed be-yond the wide seas, Old
laws are com- mend-ed be- yond the wide seas, Old
Eng-land, for ev-er, we love thee for these.
Eng-land, for ev- er, we love thee for these.

Old England, we love thee, thou land of the brave!
Our fathers fought nobly thy freedom to save.
Thy rights ever sacred, all nations must please,
Old England, for ever, we love thee for these.

Old England, we love thee, thy rocks and thy rills,
Thy dells and thy fountains, thy vales and thy hills.
Thy rivers and meadows, thy mountains and trees,
Old England, for ever, we love thee for these.

Old England, we love thee, repose of the blest,
Th' oppress'd of all nations in thee find their rest.
Thy banners of freedom float high in the breeze,
Old England, for ever, we love thee for these.

drawn exactly in the same manner. As in drawing the cone and cylinder, it is of the first importance to

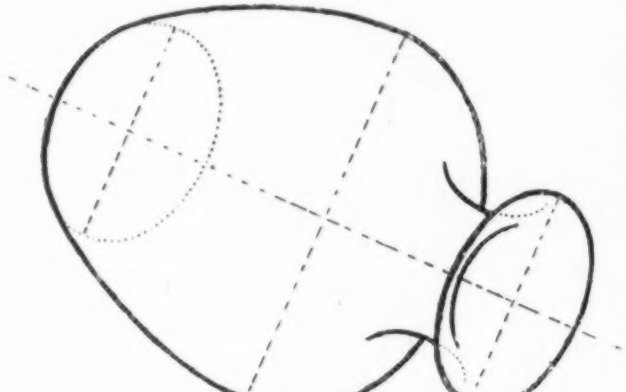


FIG. 4.

draw the cross-lines at right angles to the axis of the model.

CIRCULAR TO H.M. INSPECTORS.

INSPECTION OF SCHOOLS WITHOUT NOTICE.

Educational Department,
Whitehall, London, S.W.,
16th May, 1895.

SIR,

It is thought that a few suggestions may be useful as to the way in which the important change of practice provided for by Article 84 (*b*) of the Code of this year can best be introduced.

1. In the Revised Instructions you are informed that in the case of any school that has 'reached upon the whole a good educational standard' the annual visit may be omitted. My Lords do not wish to prescribe any rigorous uniformity in the interpretation of these words. But They are of opinion that any school for older scholars, which has obtained the Higher Principal Grant, or has shown throughout the school no distinct weakness in any one of the three elementary subjects, and any infant school that has obtained any Variable Grant, except the lowest, may be regarded as having reached the required standard.

2. You are at liberty to recommend the treatment under Article 84 (*b*) of any school falling due for inspection not earlier than next November. You should without delay make such recommendations as you think proper, if you have not already done so, for schools due for inspection in November, December, January, February, March and April; with regard to any schools due for inspection at a later date, you should recommend, on Form 10, the omission of the next annual visit, if you think it possible, and if the school satisfies the conditions laid down above. You can explain to the managers that a school, the visit to which is omitted under the Article, will not be ineligible for receiving an increased rate of grant, if the visit or visits without notice should furnish evidence of sufficient improvement.

3. In order to find time for the necessary visits without notice to schools, the inspection of which is to be omitted in November or subsequently, you are at liberty somewhat freely to recommend that grants be paid without examination under Article 84 (*a*) for schools due for inspection before November next. You should not make this recommendation in the case of any school that did not get the highest grants at the last inspection, under Article 101 (*a*), (*b*), and (*c*), or Article 98 (*a*) and (*b*), without ascertaining that the managers do not object to your so doing.

4. But when all possible use has been made of Article 84 (*a*), there will still in some Districts be difficulty in finding time for two visits without notice, at the outset of the new system. The difference in the time spent in inspecting a large and a small school under the new system will be much less than the difference under the present system. In Urban Districts, where the schools are large and few in number, the time occupied by inspection will necessarily be shorter than hitherto. In Rural Districts, where the schools are small, numerous, and extend over a large area, inspection under the new system seems likely to occupy more time than under the former system of uniform annual examination. In such Districts it will be necessary for an Inspector to economise his time very carefully, and, if possible, to arrange that one school shall be taken in the morning and another in the afternoon by at least some members of his Staff. The fact that no papers will have to be revised in the case of schools visited without notice will lighten the clerical work, and enable you and your Staff to spend more afternoons than has been hitherto possible in the schools. In course of time, as the new system becomes gradually of more general application, it will probably be possible for most of the papers worked at the schools which may remain under annual examination, to be revised on Saturdays.

5. In Urban Districts the new system will obviously be brought into operation sooner than in Rural Districts, and will probably, as has been pointed out, result in a considerable diminution of work. It may be possible therefore to make arrangements at a comparatively early date that some Inspectors in Urban Districts should give help to Inspectors in Rural Districts during some months of the year.

6. You will observe that Article 84 (*b*) says that the Inspector, in cases under the Article, 'will pay, *as a rule*, during the school year, two visits, which will *usually* be without notice.' It is not absolutely required that there should be two visits, or that the visits should be without notice. But my Lords attach great importance to the visits being without notice, and consider that, in the absence of special reasons to the contrary, all visits should be so made. Where, from the inaccessibility of the school or any other reason only one visit can be paid, that must be a visit without notice. In schools where the pupil-teachers work half-time, you might often be able to arrange your two visits so that at one or the other of them you will be able to see each pupil-teacher at work. Visits made in order that you may report on the Teaching, Reading, and Recitation of candidates for the Certificate or Queen's Scholarship Examination must be arranged beforehand, and should, as a general rule, be in addition to the ordinary two visits provided for by the Article. If the examination of candidates for Labour Certificates cannot be arranged at a visit without notice, you should consider how far you can meet the difficulty by holding periodical special examinations by arrangement with the Local Authorities.

I have the honour to be, Sir,
Your obedient Servant,
G. W. KEKEWICH.

COMING MEN.

XV.—MR. HARRY WESTON,

Member of the Committee of the National Federation of Assistant Teachers; Chairman of the London Federation Committee; Member of Central Committee of Teachers' Benevolent Fund; Member of Committee of the M.B.T.A., etc.

THE gradual change that is being brought about in the *personnel* of the Assistant Teachers of to-day is in no place more strikingly evident than in the metropolis. A brief review of the direction in which educational politics have tended during the past five years reveals the fact that the qualified class teachers of the country are realising that they possess power, judgment, and capability. In the ranks of the N.U.T., among the most ardent workers, are now to be found many class teachers whose record of Union labour cannot be excelled. The constitution of the Executive of the N.U.T. also testifies to the ability and perseverance which characterises this section of our great profession. Gradually, too, the conditions of service and the remuneration of the class teachers are improving. But for all these important details the class teachers have, in the first place, themselves to thank. They possess what is now recognised as the

best organised and most efficient organisation of teachers in the country, with the exception, of course, of the N.U.T.

They have awakened to the necessity for seeing that their demands are promulgated and enforced on true Unionist lines. There was a time, not long ago, when the forces of the class teachers were scattered and of no avail. We have periodically placed before our readers in these columns sketches of those gentlemen who distinguished themselves as pioneers in the class teachers' national movement, and whose names are to-day familiar as pillars of the greater Union to which they belong. A perusal of the whole of the sketches referred to gives us the gratifying assurance that if the future of the Union and of the teachers' cause rests with our 'Coming Men,' we need have no anxiety respecting their ability to safeguard the same. It is with no small amount of pleasure that we are able to include in this series the subject of our present sketch. Mr. Weston is well known throughout London as a staunch and hard-working Unionist, and throughout the country as one whose efforts on behalf of the class teachers have been unrelaxing.

Mr. H. Weston was born at Norwich some thirty-three years ago. He comes of a pedagogic family, and was educated in his father's school at South Hackney, London.

His apprenticeship was served at the Hammond Square Board School, Hoxton, at the completion of which he entered the Training College at Winchester, where he spent the years of 1881–2. He earned a well-deserved popularity in College, was elected Prefect by the students, placed in the First Division of the Certificate List, and fourth on his College List. From College Mr. Weston returned to the metropolis and was appointed to the Wenlock Road Board School, Hoxton. Leaving here in 1892 he was transferred to the Lauriston Road School, Hackney. It is at this school where he is now engaged as a Class Master.

His capacity for work and the possession of remarkable power of organisation soon brought him into prominence in the local associations of teachers with which he became connected. In 1885 he joined the Hackney Association, and this influential organisation having discovered the value of their acquisition, elected him General Secretary in 1889. He continued to hold this laborious office during the years 1889 to 1892.

The success that attended his efforts during this period is evidenced by the great progress made by the Association.

In 1893 he was elected Vice-President, and in the following year he occupied the unique position for a class teacher of President of an association with close upon 600 members. Mr. Weston is now ex-President of the Hackney Association.

The London Conference of the N.U.T. in 1890 was attended, as all who have had anything to do with the entertaining of Conference will well know, with the usual amount of heavy labour, and Mr. Weston was not without his share. He was appointed Secretary to the London Conference Benevolent Purposes Committee. We can leave it with our readers to discover the task he so efficiently discharged. His interest in the N.U.T. Charities is very great, indeed his efforts on their behalf are one of the features of his character. From 1890 to the present time he has been auditor to the Orphan Fund, and since 1892 he has occupied a seat at the board of the Central Committee of the Benevolent Fund. This brief summary of his connection with the N.U.T. affords ample testimony to the spirit of Unionism which permeates him. Like all ardent enthusiasts, he has been able to find time for work of different kinds. The Metropolitan Board Teachers' Association has been influenced by the advancing tide of the class teachers' organisation. Mr. Weston was intimately concerned in the action which brought about this influence, and in 1892 he was elected to the Committee of the M.B.T.A. He has been a prominent member ever since. We have found it necessary on various occasions to deal somewhat minutely with the inception of the assistant teachers' national movement, but it will suffice for our present purpose if the reader can carry his or her mind back to the Conference of Assistant Teachers held at Derby in 1893. There it was that the National Federation of Assistant Teachers was duly established. The London representatives at that Conference displayed their loyalty to its decisions by forming a branch of the Federation in the metropolis. Mr. Weston was appointed as the first Secretary, and during the present year he has exchanged the position for that of Chairman. When the deeply-lamented death of Mr. Alfred Richmond occurred, a vacancy was made on the Committee of the National Federation. Mr. Weston was unanimously chosen to fill the

place. The last Conference of the Federation, held at Birmingham in October 1894, found Mr. Weston a candidate for the Committee, and he was duly elected by the votes of his colleagues throughout the country.

He is an extremely valuable member of this Committee, his perception and ability in matters of organisation being of immense service.

In his relations with the N.U.T. it is noteworthy that he has attended no fewer than five Conferences, viz.:—Birmingham, 1889; London, 1890; Cardiff, 1891; Leeds, 1892; and Oxford, 1894. His energies are not confined entirely to questions of a strictly professional character. The Ilford Liberal and Radical Association claims him as its secretary. Mr. Weston is of opinion that the more the public knows about the teacher the more will he be appreciated, and, further, that a sufficiently valuable *quid pro quo* is received in return for such labours as may be undertaken for the benefit of the community at large, in the shape of broadened ideas and general experience. As one may naturally expect from a gentleman of Mr. Weston's opinions, he is in favour of what he calls a 'forward' policy on the part of the N.U.T.

He would like to see the Union develop on Trades Union lines, and fix standard wages, the payment of which it should be in a position, if necessary, to enforce.

'But,' said he, in reply to an observation, 'what we must strive for at the present juncture, with all the power we can command, is the closing up of all side entrances to the profession, and the consequent prohibition of the introduction of unqualified practitioners. Further, we must attempt to limit supply to waste, and be able to effectively boycott unprofessional teachers and unjust Boards of Management.'

Truly a line of policy which supplies ample scope for the Union's development.

We ventured to remark that the position of the class teacher was on the road towards improvement, and Mr. Weston waxed eloquent as he observed:—

'It is patent that class teachers must of necessity form a permanent class in the profession, and when we couple with this fact the ability and calibre of the average class teacher of to-day, it is equally evident that the present state of things cannot be perpetuated. Something must be done to establish a proper professional basis on which this important section of the profession can exist. I am not referring to our relations with managers entirely. It must be recognised that the present-day class teacher is not the assistant teacher of years ago, and therefore his professional standing in the school, and his authority over his particular class, should be clearly defined, and in no mean spirit.'

Mr. Weston informed us that he greatly admires the organisation of the Assistants' Federation. He sees in it admirable means of strengthening the N.U.T., and is convinced that it is working on the proper lines towards that end and towards the emancipation of its members.

During the past few years we have been personally in a position to form an opinion respecting Mr. Weston's labours, and we are able to speak in the highest terms of his devotion to the teachers' cause and his unstinted efforts on its behalf. Those with whom he is constantly brought into personal contact speak in most eulogistic terms of his services, and the esteem in which he is held by his colleagues and others is most creditable to himself. As a 'Coming Man' we hope to see him continue long in the path he has chosen. We feel that the future will develop still more those sterling qualities which we know him to possess. The class teachers have in him an able, experienced, and diplomatic champion, the Charities a willing worker, and the N.U.T. a member of whose ability and tact we trust they have yet by far seen the least.

OUR 1895 CERTIFICATE CLASS.

BY J. C. HOROBIN, M.A.,
Principal, Cavendish College, Cambridge.

TESTS FOR THE MONTH.

FIRST YEAR—WOMEN.

1. Write in large hand, as a specimen of Penmanship, the words—

British Honduras.

Write in small hand as a specimen of Penmanship—

Thou hast taught me, Silent River!
Many a lesson, deep and long.

2. Write the passage dictated to you by the Examiner.

It would be amusing | to make a digest | of the irrational laws | which bad critics | have framed | for the government of poets. | First in celebrity | and in absurdity | stand the dramatic unities | of place and time. | No human being | has ever been able | to find anything | that could, | even by courtesy, | be called an argument | for these unities, | except that they have been deduced | from the general practice | of the Greeks. | It requires | no very profound examination | to discover | that the Greek dramas, | often admirable as compositions, | are, as exhibitions of human character | and human

life, | far inferior to the English plays | of the age of Elizabeth. | All the greatest masterpieces | of the dramatic art | have been composed | in direct violation of the unities, | and could never have been composed, | if the unities | had not been violated.

3. (*a*) What is the difference between voluntary and involuntary attention? Show how the faculty of voluntary attention may be strengthened and developed by suitable exercises in a school.

(*b*) What purpose or purposes has a teacher in view in teaching arithmetic? Show what special mental faculties are called into exercise in the study and practice of arithmetic, and give examples.

(*c*) Give an outline of a lesson on 'The Eye, its Structure and Uses.'

(*d*) In grouping together a large number of words, having in them a common element, for example, words ending in *tion*, what generalization could be made, and how far could the scholars be helped to make the generalization for themselves? Show the value of such an exercise.

(*e*) The New Code attaches special and increased importance to the study of drawing in schools. Describe some of the earliest exercises which should be given in drawing, and say in what relation they stand to a good and complete course of general education.

(*f*) How is 'Elementary Science' provided for in the New Code? What place does it occupy in the scheme of study; and how is the work of its different departments described and graduated?

(*g*) What is meant by the 'law of habit?' Explain how the study and operation of this law are matters of practical importance to teachers who have charge of schools.

(*h*) Draw up full notes of a lesson on one of these subjects:
(i.) Westminster Abbey.
(ii.) *For Infants.* The number Twelve.
(iii.) Adjectives and adverbs.

(*i*) Take the following extract, and say (1) what words in it would need special explanation; and (2) how you could illustrate from it the difference between literal and metaphorical language:—

'How gloriously her gallant course she goes!
Her white wings flying, never from her foes:
She walks the water like a thing of life,
And seems to dare the elements to strife.
Who would not brave the battle-fire, the wreck,
To move the monarch of her peopled deck?'

(*j*) It is said in the 'Instructions to Inspectors,' that it is of little service to adopt the 'gifts' and mechanical occupations of the *Kindergarten* unless they are so used as to furnish real training in accuracy of hand and eye, in intelligence and obedience. Discuss this statement, and the reasons for it.

(*k*) How far may biography be usefully employed as auxiliary to the teaching of history? Give a few names of eminent persons who might wisely be chosen for this purpose, and sketch the life of one of them so as to show how the history of a period might be illustrated by it.

4. (*a*) Explain as fully as you can what is meant by 'nutritive food,' and name six kinds of such food in their order of value.

(*b*) Explain fully what is meant by breathing; what is the use of it, and what is the structure of the organs concerned in it.

(*c*) Show that mastication is in reality only the first stage in the digestive process; and describe the second stage of that process.

(*d*) What are the relative values of vegetable and animal food in maintaining the body in health. Name a few of the most useful articles of each class of food.

(*e*) Name the staple materials of clothing in use among the labouring class. Give some account of each and of its special value.

(*f*) There has grown up of late a considerable feeling against dyed wool and in favour of 'natural' wool. Explain why this is, and state your own opinion on the matter.

(*g*) Would you advise a young woman to buy ready-made clothing, or to make her own clothes wholly or in part? Give your reasons.

(*h*) What are the rules to be followed in choosing a house? What number of rooms ought a school-house to contain?

(*i*) Name the different articles required in the equipment of the kitchen of a school-house, their use and cost.

(*k*) What is 'draining' as applied to a house? Explain what is meant by defective draining and show its danger.

(*l*) Define what is meant by 'pure air,' and show from the nature of our body the need for a constant supply.

(*m*) What is a 'draught'? State the dangers to health arising from a draught, and mention any methods of obtaining a current of fresh air in a room without incurring any risk.

5. (*a*) Describe fully *three* stitches.

(*b*) Write notes of a lesson on any one of them.

(*c*) What do you understand by 'seams'?

(*d*) Draw a diagram of an infant's shirt, showing the various parts.

(*e*) Give directions for making it up.

6. (*a*) Write the names of the tones of the common scale in the order they are taught on the Tonic Sol-fa method.

(*b*) Write the names of:—
(1) The strong tones of the scale.
(2) ,, leaning ,, ,,
(3) ,, tones that have the greatest leaning tendency.

(*c*) Name the intervals:—

f l, r s t$_1$ l, t$_1$ d, d l

(*d*) Write an octave higher.

d s$_1$ m t$_1$ r l$_1$ d s$_1$ f m r l$_1$ m r d

(*e*) In the major scale which tone is mediant, supertonic, subdominant, leading note.

(*f*) Write the pulse signs for two-pulse measure, four-pulse measure, three-pulse and six-pulse measure.

(*g*) Write in figures the value of each note and rest in the following passage:—

| s :- .l :s.f | m : — : — | .s :l.,t :d' |
| s.f,m:r. : ‖ |

7. (*a*) Write essays on:—
(1) Little strokes fell great oaks.
(2) Writing maketh an exact man.
(3) Tennyson's harmony and melody of diction.
(4) 'The Morte d'Arthur.'

(*b*) Parse the following words:—
'Morte d'Arthur.'—5, Arthur; 8, nigh, field; 9, chancel; 11, ocean; 16, record; 24, let, what, be, be; 33, King; 35, this also; 43, hest; 88, indeed; 89, note; 140, shock; 157, wheeling him.
'Sir Galahad.'—2, sure; 14, on whom, fall.
'Demeter.'—4, can; 11, sudden; 13, welcome; 18, Queen; 103, Aconite; 113, sickening.

(*c*) Analyse—
'Morte d'Arthur.'—Lines 193—203, 265—272.
'Sir Galahad.' ,, 61—72.
'The Voyage.' ,, 65—72.
'Demeter.' ,, 86—99.

(*d*) Comment on:
King Arthur's table, chancel, unsolders, Merlin Excalibur, samite, hest, jacinth, joust, streamers of the northern morn, moving isles of water, wistfully, black stoled, dais-throne, grange, nutmeg-rocks, the stone, the wheel.

8. (*a*) 'The periods of the tides are exactly those of the bodies which raise them.' To what periods of the heavenly bodies do diurnal, semi-monthly, monthly, semi-annual, annual, periods of the tides correspond?

(*b*) 'Tides are due in their origin to astronomical causes; they are also subject to variations from terrestrial phenomena.' Mention places in the British Empire where tides are notably subject to variations due to other than astronomical causes. State briefly in each case what are the causes of the variations.

(*c*) 'A complete movement of rotation performed by the globe round its own axis does not exactly coincide with the solar day.' Why? What is a 'sidereal day'?

(*d*) Give the boundaries, approximate size and population, chief rivers, towns, and industries of Spain and Belgium.

(*e*) A vessel is bound from Marseilles to Hull. What cargo might she take on board at Marseilles, and what ports and river mouths would she pass on her voyage?

(*f*) Where are the following places:—Nuremburg, Ober Ammergau, Inverary, Granada, Ballinasloe, Navarino, Monte Carlo, Cronstadt, The Hague, Montenegro? State shortly what you know about any *six* of them.

(*g*) Where in the British Isles are the chief centres of ship-building, coal mining, linen, cotton, and woollen manufactures? Why should these industries be thus localized?

(*h*) Describe the course of the Trent and the Rhone, naming the tributaries they receive, the chief towns on their banks, and their manufactures.

(*i*) Draw an outline map of Ireland, marking the principal physical features and towns, and write a short description of its climate and productions.

(*j*) What districts in Europe are noted for wheat, oats, maize, butter, olive oil, silk, pilchards, sponge, cork, currants, salt, and where do the Basques, Magyars, Czechs, Fins, Slavs, Samoiedes, Cossacks, and Neapolitans live?

9. (*a*) Give an account of the state of agriculture in the 18th Century.

(*b*) Who wrote 'Pleasures of Memory,' 'Palestine,' 'Rejected Addresses,' 'Queen's Wake,' 'Rokeby,' 'Fudge Family in Paris,' 'Lalla Rookh,' 'The Excursion,' and 'The Traveller'?

(*c*) Write a short account of Byron, Scott, Johnson.

(*d*) Give an account of the causes which led to the Peterloo massacre and the Six Acts.

(*e*) Give an account of the Holy Alliance, Alien Bill, and the Indemnity Bill.

(*f*) Write an account of the causes and chief events of the American War of Independence.

(*g*) Write a short biography of Wellington, Nelson, Napoleon, and Washington.

10. (*a*) By what fraction of a ton is $(\frac{3}{7} + \frac{9}{20})$ of a cwt. greater than $\frac{5}{8}$ of $\frac{3}{8}$ of a qr.?

(*b*) A publican, having bought a barrel (36 galls.) of beer at eighteenpence a gallon, less a discount of 2s., retails $\frac{1}{4}$ of it at 4d. a pint, and then fills up $\frac{2}{3}$ of the vacant space with water, and sells the mixture at the same price. How much per cent. does he gain on the barrel?

(*c*) If a sixpenny loaf weigh 4·35 lbs. when wheat is at 5·75s. a bushel, what should be paid for 98·6 lbs. of bread if wheat were 9·2s. per bushel?

(*d*) Explain why certain vulgar fractions cannot be expressed accurately as decimals. How can you tell such fractions by simple inspection? Give examples.

Divide 2·52 by ·0072.

(*e*) A roof, measuring 18 ft. along the ridge, and 10 ft. 8 in. from ridge to eaves, has to be covered with slates 16 inches long and 8 broad, each slate overlapping the one below it by 2 inches. Find the cost of the slates at 16d. a dozen.

(*f*) Three partners gain £3,650: the first advances one-third of the capital for one-fourth of the time; the second, one-fourth of the capital for one-half of the time; and the third, the remainder of the capital for the whole time. Find their respective shares of the profit.

(*g*) By selling 8 tons of tea at 1s. 6½d. per lb. a merchant loses 7½ per cent. At what price should he sell it in order to gain 10 per cent.?

(*h*) A boat, with 2,720 sq. ft. of sails spread, travels 51 knots in 8½ hours when the wind gives a pressure of ·125 lbs. per sq. ft. How far will it go in 2⅔ hours with a sail area of 7,650 sq. ft. and a wind pressure of ·5 lbs. per sq. ft., assuming the speed to be proportioned to the area of the sail and the wind-pressure?

(*i*) How would you make children understand the mistake committed in the following:—

$$\frac{2}{3} + \frac{1}{4} \text{ of } \frac{5}{6} - \frac{3}{8} = \frac{8+3}{12} \times \frac{20-9}{24} = \frac{11}{12} \times \frac{11}{24} = \frac{121}{288}?$$

Simplify

$$\frac{\frac{5}{7} - \frac{2}{5}}{5 - \frac{2}{5} \text{ of } \frac{2}{10}} \div \frac{\frac{1}{2} \text{ of } \frac{7}{10\frac{1}{2}}}{1\frac{2}{3} + \frac{1}{5}}.$$

(*j*) At what rate per cent. simple interest will £4,317 10s. amount to £5,019 1s. 10½d. in 4 years 4 months?

FIRST YEAR—MEN.

1–3, 6–9. As Women.

10. (1) Explain clearly, as to beginners in fractions, why the addition of fractions with different denominators is effected by reducing each of the fractions to their least common denominator.

(2) How do you know, before proceeding to divide, whether a vulgar fraction can be expressed as a non-circulating decimal?

(3) What would be the advantages, and what the disadvantages, in adopting the decimal system in money, weights, and measures?

(4) Give rules for rapid mental solution in the following cases:—(1) Cost for a year at so much per day; (2) any number of things at £83 6s. 8d. each; (3) simple interest at 6¼ per cent. per annum.

(5) If water expands when freezing so that a cubic foot of water becomes 1·089 feet of ice, find to two place of decimals how many cubic feet of water there are in a block of ice 9 feet long, 8½ feet broad, and 8½ feet high.

(6) What is the smallest sum of money which will exactly contain each of the following sums: 4s. 2d., 6s. 4d., 11s. 11d., 17s. 5d.?

(7) Reduce to their simplest forms:—$\frac{4608}{8631}$, and $\frac{171}{244}$ of $\frac{144}{189}$ of $\frac{9}{152} + \frac{123}{144}$ of $\frac{222}{268}$.

(8) Find the value of $\frac{\cdot 56}{\cdot 50}$ of 4 tons 6 cwt. 58 lbs., and reduce the result to the decimal of a ton.

(9) If it costs £34 1s. 3d. to decorate a wall space measuring 23 ft. 4 in. by 7 ft. 1 in., what will it cost for one measuring 5⅜ yards by 2½ yards, the style of decoration used in the second case being two-thirds as expensive as in the first case?

(10) One clerk has 114, and a second clerk has 75 sheets to engross; they call in a third clerk, and agree to divide the work equally among the three, and to pay the third clerk a guinea. How much of this should the first clerk pay?

(11) A banker offered to take French bronze pennies from the public at the rate of 13 for a shilling. If he exchanged them again at the rate of 252 for a sovereign, what would he gain or lose on every thousand bronze pennies so received?

(12) Calculate $\frac{1}{\sqrt{\cdot 5}}$ correctly to four places of decimals.

(13) Find the length of the edge of a cube of metal which cost £2,703 14s. 5¾d.; the value of a cubic inch being 4s. 2d.

(14) Find the true discount on £309 19s. 11½d. due 6 months hence at 3 per cent. per annum.

(15) Find the exact difference between the simple and compound interest on £8,675 for 4 years at 6 per cent. per annum.

(16) A man invests a certain sum in the ordinary stock of a railway at 80, which pays a dividend of 3¼ per cent. at the end of a year. He then sells out at 84, and invests the proceeds in a 5 per cent. stock at 125, and thus in the second year improves his income by £6 12s. How much did he originally invest, assuming that the prices of the stocks given above include brokerage, etc.?

11. (1) Prove the rule for finding the greatest common measure of two algebraical expressions, and find the least common multiple of—

$$x^2 - 3x + 2,$$
$$x^2 - 5x + 6,$$
and $$x^2 - 7x + 12.$$

(2) Many pupil-teachers, when asked to prove a formula, simply give a numerical illustration. Explain why this is worthless.

Prove that a multiplied by b is equal to b multiplied by a, where a and b are *any* positive integers.

(3) Find the square root of

$$x^6 - 8x^5 + 24x^4 - 34x^3 + 24x^2 - 8x + 1.$$

What must be the value of a in order that

$$x^4 + 2x^3 + 5x^2 + 4x + a$$

may be a perfect square?

(4) Solve the equations—

(1) $\frac{4x-3}{2} - \frac{5x-4}{3} = \frac{6x-5}{4} - \frac{1}{12}$.

(2) $(x-3)(x-4)(x+12) = x^3$.

(3) $\begin{cases} x+y=8. \\ 15x^2 - 34xy + 15y^2 = 0. \end{cases}$

(5) Prove that the square of the sum of any two numbers + the square of their difference = twice the sum of the squares of the numbers.

Also that the sum of the cubes of three even numbers in arithmetic progression is divisible by 24.

(6) Simplify—

$$\frac{ab(a-b)-a^2(a-1)+b(b-1)}{(a-b)(a-1)(b-1)},$$

and find the value of

$$(x^2+xy+y^2)(x^2-xy+y^2),$$

when $x=2^{\frac{1}{2}}$ and $y=3^{\frac{1}{2}}$.

(7) A bag contains sovereigns and shillings. If the number of sovereigns is doubled, the contents of the bag will be worth £21; but if the number of shillings is doubled, the contents will be worth only £12. Find how many coins of each kind are in the bag.

(8) Prove that a ratio of greater inequality is diminished, and a ratio of less inequality is increased, by adding the same quantity to both its terms.

If $a:b::c:d$

then $$\frac{a^2-ab+b^2}{(a-b)^2}=\frac{c^2-cd+d^2}{(c-d)^2}.$$

(9) Find to the nearest foot the diameter of a circle whose area is half an acre.

(10) A circle and an equilateral triangle have equal perimeters; compare their areas.

12. N.B.—Capital letters (*excluding A, B, C, D, E, F*), not numbers, must be used in the diagrams.

All generally understood abbreviations and symbols for *words* may be used, but not symbols of *operation*, such as —, +, ×, PQ², PQ.RS.

(1) Construct a triangle whose sides are equal to three given straight lines, any two of which are together greater than the third.

Show by diagrams what will happen if you attempt to construct triangles whose sides contain units in the following relations:—(1.) 2, 3, 4; (2.) 2, 3, 5; (3.) 2, 3, 6.

(2) If a straight line falling on two other straight lines make the alternate angles equal to one other, or make the interior angles on one side together equal to two right angles, these two straight lines shall be parallel.

Show that a four-sided figure which has all its sides equal and one angle a right angle is a square.

(3) To divide a given straight line into two parts, so that the rectangle contained by the whole and one of the parts may be equal to the square of the other part.

Show how to produce a straight line, so that the rectangle contained by the given line and the line made up of the given line and the part produced may be equal to the square of the part produced.

(4) In any acute-angled triangle the squares of the sides containing the acute angle are together greater than the square of the side subtending the acute angle by twice the rectangle contained by one of the sides and the straight line intercepted between the acute angle and the perpendicular let fall on it from the opposite angle.

The straight line PQ is divided in R, so that the rectangle PQ, QR is equal to the square of PR. Circles with centres Q, R, and radii equal to PR intersect in S. Show that PQS is an isosceles triangle, having each of the angles PQS, PSQ double of QPS.

(5) Equal triangles upon the same base and upon the same side of it are between the same parallels.

Bisect a given triangle by a straight line drawn from a given point in one of its sides. (I. 37, 38.) ..

(6) Show that Propositions 2 and 3 of the Second Book are special cases of Proposition 1. What are the corresponding algebraical formulæ for these three propositions?

(7) If a straight line be divided into two equal and also into two unequal parts; the squares of the two unequal parts are together double of the square on half the line and of the square on the line between the points of section.

In PR, a diagonal of the square PQRS, a point T is taken. Show that the triangle whose sides are equal to PT, TR and the diagonal of a square described on QT will be right-angled.

Notes on the Questions.

3. (*a*) Voluntary attention is controlled by the will, involuntary is generally speaking automatic. The training of the intellect is largely a question of conquering uncontrollable *interest*.

(*g*) A fixed disposition and a faculty to do a thing resulting from numerous repetitions of the action.

(7) The essay is now separately marked, and great care should be taken to arrange the subject matter logically on the scrap *before* beginning the writing.

(8) Wherever possible in Geography, put a sketch map to illustrate your answer.

Get up carefully the distribution of the various races inhabiting Europe and the languages used.

A map showing the changes in European boundaries since 1860 might come in usefully.

Answers.

Arithmetic.—Women.

10. (*a*) 151/3600.
(*b*) 100 per cent.
(*c*) 18s. 1⅛d.
(*d*) 350.
(*e*) £2 14s.
(*f*) £486 13s. 4d.; £730; £2,433 6s. 8d.
(*g*) 1s. 10d. per lb.
(*h*) 180 knots.
(*i*) 20/63.
(*j*) 3¾ per cent.

Arithmetic.—Men.

10. (5) 574·54 c. ft.
(6) £1,132 1s. 8d.
(7) 11/13; 677/804.
(8) 4·275.
(9) 15 guineas.
(10) 17s.
(11) 2s. $5\frac{53}{171}$d.
(12) ·3535.
(13) 1 ft. 11½ in.
(14) £4 11s. 7½d.
(15) £194 19s. 9·03072d.
(16) £4,800.

Algebra.

11. (1) Page 9, No. 4, Horobin's Solutions to Certificate Tests (Gill).
(2) Page 17, No. 4, ibid.
(3) Page 20, No. 4, ,,
Page 21, No. 4, ,,
Page 23, No. 2, ,,
(5) Page 25, No. 3, ,,
(6) Using $F(x)$ theorem N is proved to be equal to $(a-b)(a-1)(b-1)$.
Multiply the expressions and we get $x^4+x^2y^2+y^4$, which on substitution gives 19.
(7) Page 29, No. 4, ,,
(8) Page 14, No. 12, ,,
(9) Page 60, No. 18, ,,
(10) Page 60, No. 19, ,,

Second Year.—Women.

1 and 2. As in First Year.

3. (*a*) A boy comes to school for the first time on January 10th, and leaves the neighbourhood without expectation of return on March 10th. During these months he stays away on some days from illness, on others from truancy. On the 10th of May he returns with the expressed intention of remaining for another year at school, but he goes out to work for the three summer months. Then he becomes recognised as a half-timer, and continues alternately at work and at school, till he finally leaves on December 10th.

(1) Give all the entries that should be made for such a boy both in admission and class registers.

(2) Show how the average of a school, whose meetings were 400 in number, would be affected by the presence of 10 such boys attending for a period equivalent to twelve weeks each during the year.

(*b*) What are the processes of thought involved in (*a*) the classification of objects; (*b*) the use of an abstract noun; and (*c*) the use of a syllogism?

(*c*) Give some familiar examples of false induction; and say what kind of school exercises are best calculated to encourage the habit of making a true use of the inductive process.

(*d*) What is the exact meaning of 'organisation' as applied to a school? Say how you would organise the work of a mixed school of 200 children, of whom 50 were under seven years of age, what staff you would require, and how you would distribute the work among them.

(*e*) Explain and illustrate by examples the following terms:—Ambiguity. Fallacy. Premiss. Suppressio veri. Suggestio falsi. Hypothesis. Illative.

(*f*) How is the general principle that we should in teaching 'proceed from the simple to the complex' explained and illustrated in your own experience?

(*g*) Write out the notes of a lesson on one of these subjects:—

(*a*) Gibraltar.
(*b*) *For Infants.* Bread.
(*c*) The planetary system.

(*h*) It is said that the principles of Froebel are applicable not only to the Infant School, but also to the discipline and instruction of older children. Explain this, and show in what way the manual and other exercises of the 'Kindergarten' might be extended or modified so as to be useful in the upper classes of a school.

(*i*) Discuss the relative advantages and disadvantages of the different methods of warming a schoolroom.

4. (*a*) Give recipes for varieties of milk puddings, with accurate directions as to the proper modes of preparation. What precautions are necessary in the care of milk?

(*b*) Mention the most suitable forms of nutriment for an invalid forbidden to take solid food.

(*c*) What qualities constitute the character of a good maid-servant? How may such qualities be best encouraged during school-life?

(*d*) What are the principal constituents of bread? Distinguish the different kinds of flour. Add any remarks on 'short weight.'

(*e*) Give heads of general principles to be taught to a cookery class, as preparatory to their practical application.

(*f*) Mention the ordinary causes of the beginning of fevers, and explain the practice of 'isolating' infectious cases.

(*g*) To what extent are shell-fish and preserved fruits useful articles of diet?

5. (*a*) Cut out, and make up one half of a boy's shirt (lined paper).

(*b*) On the calico supplied show not less than three inches of the following stitches:—

Hemming, sewing, stitching, and feather stitching.

(*c*) Darn a hole in stocking-web material.

6. (*a*) Write in the *Lah* mode (*a*) an ascending minor scale, using the minor or essential sixth and the major or essential seventh; and (*b*) a descending minor scale, using the minor or occasional seventh and the minor or essential sixth.

(*b*) Write the following intervals:—

(*a*) Above *lah* an augmented sixth. (*b*) Above *se* a diminished third. (*c*) Above *doh* an augmented fifth.

(*c*) *Ta* is the name for *te* flat. What do the following names show?

(1) **ro** (2) **le** (3) **la** (4) **fe** (5) **ra** (6) **se**

(*d*) Re-write the following on the 'imperfect' method. Regard the first note in (1) as *doh*^{1}, and the first note in (2) as *me*:—

(1) **s l f m r f t, d r m fe s d' t**
(2) **l t d s l f s m f l s l t d'**

(*e*) Write figures over the following to indicate the value (as 1 pulse, ½ pulse, etc.) of each note and rest:—

| m ,f, s : d . | m, - ,f : s . | l ,, s : f, m r | s : - . ||

(*f*) Fill up two measures of each of the following kinds. Begin each measure with a strong accent. Vary the contents of the measures in each time.

(*a*) Four-pulse; (*b*) Six-pulse; (*c*) Three-pulse; (*d*) Nine-pulse.

(*g*) Note tests for Division IV. in schools include:—

(*a*) A simple passage in the major key containing a transition of one remove indicated by bridge-notes; and

(*b*) A short passage in the minor key or mode, introducing se used thus l se l, but without introducing f, ba or soh.

Write two passages, of about twenty notes each (without time) in accordance with these requirements.

(*h*) Time tests for Division IV. in schools include:—

Series of notes in two-pulse, three-pulse, or four-pulse measure, including pulse-and-a-half notes.

Write two passages, one in three-pulse measure and one in four-pulse measure, of four measures each, in accordance with these requirements. Use no rests shorter than a whole pulse, and no notes shorter than a half-pulse. Write the pulse-signs plainly and boldly and use '*d*' for the notes throughout. Vary the contents of the measures in each time.

(*i*) Transcribe the following passage into six-pulse measure (*i.e.*, write in three pulses what is here in one pulse):—

| m :d ,r ,m | f :— | s, - ,f :m, - ,f |
| s : | f, ,s, ,f :m ||

7. (*a*) (1) Write an essay on the life and works of Bacon.

(2) Write an essay on the 'dramatic genius' of Shakespeare, illustrating from King Lear.

(3) The historical novel.

(4) Revenge triumphs over death.

(*b*) (1) Derive the words embaseth, dissimulate, surfeit, hyperbole, trivial, attempter, traducer, Alcoran, solecism, yeoman, vaunt-couriers, pigmy, paun, sennet, maugre, miscreabit, caitiff, benison.

(2) Explain the meaning and allusions in the following:—The massacre in France—death of Pertinax—a single life doth well with Churchmen—Wiernverale of Kings—Pragmatic sanction—dry light is ever the best—practice against the state—wild justice Argus—Briareus—sumptuary laws—mysteries of Hecate—gasted—thouzed—scant my sizes—one that gathers sampere.

(3) Give examples from Lear of:—Double comparative, double negative, alliteration, indirect object, subjective genitive, unusual accent, unusual or obsolete participial forms, anacronism.

(4) Give an account of what Bacon has to say of 'Great Place,' illustrating from his own life.

(5) Show that the fool is 'not altogether a fool.'

(6) Give examples of obsolete forms of words from King Lear and the Essays.

8 and 9. As in First Year.

10. (*a*) Show, from the law of arithmetical involution, that the squares of two numbers which differ from each other by unity, differ by the sum of the two numbers, *e.g.*, $6^2 - 5^2 = 6 + 5$. Give the reasons fully.

(*b*) State what arithmetical truths are expressed in the following formulæ. *Prove* three of them and give a numerical illustration of each:—

(1) If x is $\frac{a}{b}$ of y; y is $\frac{b}{a}$ of x.

(2) $(a - b) = (a + n) - (b + n)$.

(3) $\frac{a}{b} < \frac{a+c}{b} > \frac{a}{b+c}$

(4) $\frac{a}{b} = \frac{an}{bn} = \frac{a \div n}{b \div n}$

(5) If a is a measure of b and c, it is a measure of $b + c$, $b - c$, or $c - b$, and of nb and nc.

(*c*) In a race of 100 yards, A allows B 4 yards and C 6 yards start, in order that they may reach the goal together. How much start should B allow C when B has to run the whole distance?

(*d*) In a certain school 80 per cent. of the scholars examined pass in Arithmetic, one-tenth more in Writing than in Arithmetic, and one-eleventh more in Reading than in Writing. If the passes in Reading number 120, how many scholars were examined?

(*e*) Explain the difference between true discount and banker's discount. Find the amount of a bill due eight months hence, if the true discount, at 3 per cent. per annum, is £11 12s.

(*f*) Reduce $\frac{1}{3}\frac{9}{7}\frac{8}{2}$ lbs. and $\frac{8}{1}\frac{8}{0}\frac{8}{1}$ qrs. each to the decimal of a cwt., and add the results together.

(*g*) A contractor, having undertaken to make a railway in one year, employs 750 men for 4½ mo nths, and then finds he has done $\frac{3}{5}\frac{3}{6}$ of his work. How many men must he employ for the remaining time, in order to complete his contract as agreed?

(*h*) I invested £4,257 in 2¾ per cent. consols at 96⅝, and subsequently sold out half my holding at the same price, investing the proceeds in 5 per cent. Indian Railway Stock at 120½. Find the difference in my income. (Reckon brokerage at ¼ per cent.)

(*i*) Subtract the square of 2¼ from the square root of $62\frac{49}{144}$.

(*j*) Show that the least integer which contains two or more fractions an exact number of times is the Least Common Multiple of their numerators.

(*k*) The net profits of a company for the half-year just ended amount to £60,451, and £10,297 is brought forward from the previous half-year. After transferring £20,153 to the reserve fund, and carrying £13,095 to the next half-year's account, sufficient is left to pay a dividend at the rate of 15 per cent. per annum. What is the capital of the company?

(*l*) Three girls begin skipping at exactly the same moment. They jump at intervals of ·6, ·75, and ·8 seconds respectively. How long will it be before they again jump simultaneously?

SECOND YEAR.—MEN.

1–3. As Second Year, Women.

6–9. As Second Year, Women.

10. (*a*) Prove that the sum of the squares on any number of unequal quantities is less than the square of their sum.

In an examination it was found that the aggregate marks of each candidate came to the same amount. The examiner then assigned to each the square of the marks originally gained by him for each subject; prove that if one candidate, and one only, was totally ignorant of every subject but one he would come out head of the list.

(*b*) Prove that the sum of the roots of the equation

$$x^2 + px + q = 0 \text{ is equal to } -p,$$

and the product $= q$.

Form the equation of which the roots are $mu + nv$, $mv + nu$, where u and v are the roots of the equation

$$x^2 + x + 1 = 0.$$

(*c*) Solve the equations:—

$$(1)\quad \sqrt[3]{x} + \sqrt[3]{x+1} = 1.$$

$$(2)\quad \left.\begin{aligned} x - y &= m \\ nx + my + y^2 &= 0 \end{aligned}\right\}.$$

(*d*) For 3s. two yards more of cheap calico can be bought than of better quality, and 10 yards of the latter cost 6d. more than 12 yards of the former; find the price per yard of each quality.

(*e*) Having the number of combinations of n things taken r together, find the number taken $r+1$ together.

In a company of 80 soldiers 5 are detailed daily for fatigue duty; how many different selections can be made, and on how many occasions will a given soldier escape duty?

(*f*) Find the greatest term in the expansion of $(1+x)^n$ when n is a positive integer.

Find the coefficient of the term involving $x^n y^n$ in the expansion of $(1 + x + y + xy)^{2n}$.

(*g*) A contractor employs two gangs of workmen equal in number, but a workman of one gang does as much in four days as a workman of the other in five. The wages of the superior workman are 28s., of the inferior 21s. per week. The contractor finds that if he employs both gangs on a piece of work he will spend £175 more but finish the work in 25 weeks less than if he employed the inferior gang only. Find how many men he employed.

(*h*) Find, to two places of decimals, the edge of a cube whose volume is the same as that of a sphere, 3½ feet in diameter.

11. (*a*) If a straight line drawn through the centre of a circle bisect a straight line in it which does not pass through the centre, it shall cut it at right angles; and conversely, if it cut it at right angles, it shall bisect it.

Draw a line cutting two concentric circles, so that the part of it intercepted by the circumference of the greater may be double the part intercepted by that of the less.

(*b*) The straight line drawn at right angles to the diameter of a circle at one of its extremities falls without the circle, and no straight line can be drawn from the extremity between that straight line and the circumference so as not to cut the circle.

P is a point without a circle whose centre is O. If a circle be described on OP as diameter, cutting the given circle in Q, PQ will touch the given circle.

(*c*) The opposite angles of any quadrilateral figure inscribed in a circle are together equal to two right angles.

Two circles intersect in P, Q; through P and Q two lines RPS, TQV are drawn parallel to each other, meeting the circles in R, S and T, V. Show that RTVS is a parallelogram.

(*d*) If from any point without a circle two straight lines be drawn, one of which cuts the circle, and the other touches it; the rectangle contained by the whole line which cuts the circle, and the part of it without the circle, shall be equal to the square on the line which touches it.

Two circles intersect in P, Q. If tangents be drawn to the circles from any point R in PQ produced they shall be equal.

(*e*) In a circle, the angle in a semicircle is a right angle; but the angle in a segment greater than a semicircle is less than a right angle; and the angle in a segment less than a semicircle is greater than a right angle.

PQR is a triangle, PS, RT, meeting in V, are drawn perpendicular to the opposite sides. QV is produced to meet PR in W. Show that QW is perpendicular to PR.

(*f*) To inscribe a circle in a given triangle.

M is the centre of the circle inscribed in the triangle PQR; and N is the centre of the circle which touches PQ and PR produced and QR. Show that MN is the diameter of a circle which passes through Q and R.

(*g*) To inscribe an equilateral and equiangular hexagon in a given circle.

Compare the areas of regular hexagons inscribed in and described about a given circle.

ANSWERS.

Arithmetic.—Second Year Women.

(*c*) 2 1/12 yds.
(*d*) 125.
(*e*) £591 12s.
(*f*) ·169729.
(*g*) 1050.
(*h*) £27 10s.
(*i*) 1 31/98.
(*k*) £500,000.
(*l*) 12 sec.

Algebra.

(*a*)	Page 2, No. 5.	Horobin's Solutions.	Certificate Test.
(*b*)	,, 26, ,, 4.	,,	
(*c*)	,, 20, ,, 6.	,,	
	,, 23, ,, 7.	,,	
(*d*)	,, 30, ,, 12.	,,	
(*e*)	,, 15, ,, 9.	,,	
(*f*)	,, 18, ,, 8.	,,	
(*g*)	,, 31, ,, 13.	,,	
(*h*)	,, 61, ,, 19.	,,	

EXAMINATIONS IN GOVERNMENT AND CITIZENSHIP.

THE subject or group of subjects embraced in Mr. Acland's Education Code for Evening Continuation Schools under the title of the 'Rights and Duties of Citizens' is both popular and important. Its introduction into the curriculum for evening classes was a recognition of the importance of imparting to our youth definite instruction on those practical duties and social relations which await them as soon as they enter upon the active work of life as members of the body politic.

At first, books on the subject were almost entirely wanting, and those who would teach it had to seek the materials for their lessons from various sources. Now, after two years, many books dealing with the matter exist. Some have been perhaps hastily written, and therefore afford imperfect guidance; but others are careful compilations, and supply much that is valuable.

The importance of the subject has been recognised not only by the producers of educational books, but by the organisations for the Extension of University Teaching, and courses of lectures have been arranged for and given under the auspices of the London Society for this object. These lectures have been specially directed to assist teachers of the subject, and by this class they have been largely attended. Among the lecturers have been Mr. Graham Wallas, now a member of the London School Board, and Mr. Henry Cunningham, who has had much experience in lecturing on similar branches of knowledge.

Students who regularly attend the lecture course for three terms, who work a certain number of written exercises for the lecturer, and who satisfactorily pass three terminal examinations, are able to obtain a sessional certificate which will testify to their knowledge of the subject, and will afford valuable evidence, if they are teachers, of their ability to teach it in the Continuation Schools.

Two of these terminal examinations have already been held during the past few months at the Hugh Myddelton School Centre, the examiner being Mr. F. C. Montague, M.A., Professor of History in University College, London.

We are glad to be able to place before our readers the papers of questions set at these examinations, as they may be useful and suggestive to those who have not had the advantage of attending the course of lectures, but who are desirous of learning and teaching the subject on the most approved lines.

From a consideration of these questions the reader may gather how practical is the nature of the subject, and how wide is its range as treated in the lectures, and also how much it depends upon, and is interwoven with, constitutional history and legal and economic principles, while it is intimately concerned with ordinary social relations.

EXAMINATION IN 'THE GOVERNMENT OF GREAT BRITAIN AND THE RIGHTS AND DUTIES OF ENGLISH CITIZENS' (Part I.).

Michaelmas Term, 1894.

Time allowed: 3 *hours.*

(*N.B.*—Candidates must not attempt more than nine questions.)

1. How would you account for the inability of the Anglo-Saxon kingdom to maintain itself against foreign invasion?
2. What causes facilitated the restoration of national unity after the Norman Conquest?
3. Why were the Tudors able to make the Crown so powerful, and why were the Stuarts unable to keep the power which they had received from the Tudors?
4. Point out the chief results of the modern growth of commerce and industry upon the English Constitution.
5. What Prerogatives are vested in the Queen (*a*) as the Head of the Church; (*b*) as the Fountain of Justice?
6. Give a full account of the different qualifications which entitle to a seat in the House of Lords.
7. What is meant by 'Privilege of Parliament'? Give examples of conflict between the House of Commons and the Courts of Justice on questions of Privilege.
8. What is meant by a 'Private Bill'? Give a full account of the procedure observed with Private Bills.
9. Write a history of the office of Secretary of State.
10. Explain the following:—
    Concilium Ordinarium;
    Court of Record;
    Grand Committee;
    Habeas Corpus Act;
    Master of the Rolls;
    Treasure-trove.
11. Can you give any examples of particular religious or philosophical ideas which have exerted a powerful influence on English constitutional history?
12. What do you know about the condition of the labouring classes in England between the Norman Conquest and the Wars of the Roses?
13. Enumerate the superior Courts of Justice previous to the passing of the Judicature Act of 1873, and sketch the history of each of them.

EXAMINATION IN 'THE GOVERNMENT OF GREAT BRITAIN, AND THE RIGHTS AND DUTIES OF ENGLISH CITIZENS.' (Part II.).

Lent Term, 1895.

Time allowed: 3 *hours.*

(N.B.—Candidates must not attempt more than nine questions.)

1. Describe the jurisdiction possessed by the Ecclesiastical Courts (*a*) in the twelfth century, (*b*) at the present day.
2. By what steps was the principle of religious toleration established in this country?
3. What influence did Feudalism exert on English local government?
4. Describe the constitution and powers of the new Parish Councils.
5. What do you understand by a University? What do you know of the history of the English Universities?
6. What evils was the Poor Law Amendment Act of 1834 intended to remedy, and how far has it been successful?
7. Sketch (*a*) the constitution, (*b*) the powers of the various Sanitary Authorities now existing in England.
8. What provision has been made in successive ages for the preservation of public order in England?
9. Trace the progress of an English criminal prosecution from the arrest to the sentence. Can you suggest any improvement in the procedure?
10. What is meant by the distinction between Real Property and Personal Property, and what are its chief practical consequences?
11. Distinguish a Tort from a Crime, and describe the principal species of Tort.
12. To what extent are the relations of Master and Servant determined (*a*) by the voluntary agreement of the parties, (*b*) by law?
13. Explain the following terms:—
    Advowson;
    Bill of Sale;
    Copyright;
    Felony and Misdemeanour;
    Lammas Lands;
    Negotiable Instrument;
    Petition of Right;
    Sheriff's Tourn and Leet.

QUERY COLUMN.

Molyneux.—A mason has two cubes of marble containing together 1,072 cubic inches. When placed on the ground they together cover 130 square inches. What are their dimensions?

Let x = side of one,
y = side of other.

Then $x^3 + y^3 = 1072$, (A)
$x^2 + y^2 = 130$; (B)

that is, $(x+y)^2 - 3xy(x+y) = 1072$, (A)
$(x+y)^2 - 2xy = 130$. (B)

Let $x + y = a$;

then $a^3 - 3axy = 1072$, (A)
$a^2 - 2xy = 130$. (B)

Multiply (A) by 2 and (B) by $3a$,

$3a^3 - 6axy = 390a$, (B)
$2a^3 - 6axy = 2144$, (A)

subtract, $a^3 = 390a - 2144$,

$\therefore a^3 - 390a + 2144 = 0$,

$\therefore a^3 - 256a - 134a + 2144 = 0$,

i.e. $a(a^2 - 256) - 134(a - 16) = 0$. (C)

Since $a - 16$ divides all terms,

$\therefore a - 16 = 0$, and $a = 16$,

$\therefore x + y = 16$, and $x = 16 - y$.

Substitute this value in (B);

then $(16-y)^2 + y^2 = 130$,

$\therefore y^2 - 32y + 256 + y^2 = 130$,

$\therefore y^2 - 16y + 63 = 0$,

$\therefore y = 9$ in. or 7 in.,

$x = 7$ in. or 9 in.

The value $a(a + 16) - 134 = 0$, got by dividing equation (C) by $a - 16$, gives impossible values for x and y.

X.Y.Z.—Find two numbers such that the sum of their arithmetical, geometrical, and harmonical means is $9\frac{1}{5}$, and the product of these means is 27.

Let a and b = the numbers.

Then arithmetical mean $= \frac{a+b}{2}$, geometrical mean $= \sqrt{ab}$, and harmonical mean $= \frac{2ab}{a+b}$.

$$\therefore \frac{a+b}{2} + \sqrt{ab} + \frac{2ab}{a+b} = \frac{49}{5}. \quad (A)$$

$$\frac{a+b}{2} \times \sqrt{ab} \times \frac{2ab}{a+b} = 27. \quad (B)$$

$$i.e., \quad \sqrt{ab}\,(ab) = 27. \quad (B)$$

Square both sides,

$$\therefore a^3b^3 = 729, \text{ and } ab = 9.$$

Substitute this value in (A);

$$\therefore \frac{a+b}{2} + 3 + \frac{18}{a+b} = \frac{49}{5}.$$

Multiply all terms by $10(a+b)$.

$$\therefore 5(a+b)^2 + 30(a+b) + 180 = 98(a+b);$$

$$\therefore 5(a+b)^2 - 68(a+b) + 180 = 0.$$

Factorise, $\therefore \{5(a+b) - 18\}\{(a+b) - 10\} = 0;$

$$\therefore a+b = 10 \text{ and } 3\tfrac{3}{5};$$

$$\therefore a = 10 - b \text{ and } 3\tfrac{3}{5} - b.$$

But since $ab = 9$, $a = \frac{9}{b}$;

$$\therefore \frac{9}{b} = 10 - b.$$

Multiply by b; $\therefore 9 = 10b - b^2;$

$$\therefore b^2 - 10b + 9 = 0;$$

$$\therefore (b-9)(b-1) = 0;$$

$$\therefore b = 9 \text{ or } 1; \quad \therefore a = 1 \text{ or } 9.$$

The value $a = 3\frac{3}{5} - b$ gives impossible values for b.

Montrose.—There are 10 numbers, each consisting of 5 figures, find (*a*) the greatest number of possible figures in their sum and product respectively; (*b*) the least number of possible figures.

(*a*) The numbers must lie between 10,000 and 100,000, that is, must express the *fourth* power of 10. Since none of the numbers can possibly reach 100,000, which contains six figures, the sum of 10 of them must be less than 1,000,000, and more than 100,000, that is, the sum of ten of them must contain six figures. This answers the question as to both the least and the greatest number of possible figures in their sum.

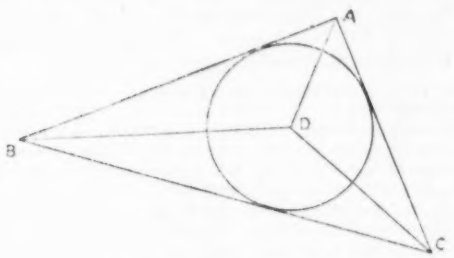
The numbers may approach as nearly as possible to 100,000, that is, to the *fifth* power of 10, but cannot equal this power. The product of ten of the largest of such numbers must, therefore, produce a power of ten which is *one power less than the fiftieth power of that number*. Since the forty-ninth power of ten contains fifty figures, this is the greatest number of figures possible in their continued product.

(*b*) On the other hand, the lowest values expressed by numbers of five figures only just exceed the *fourth* power of ten. The continued product of ten numbers of five figures, all expressing the lowest values which can be expressed by numbers containing five digits, must exceed the *fortieth* power without equalling the *forty-first* power of ten. Since the fortieth power of ten contains forty-one figures, this is the least possible number of figures.

Pax (*Gibraltar*).—Some amateur mathematicians are of opinion that the area of the circle described in the 3, 4, 5 triangle cannot possibly be 3·1415926, etc., and that the ratio of the circle to the right angled triangle in question is that of 37 to 75. Up to this I have not seen it vouched for anywhere in print, but that the Pythagorean Theorem says so is, to my mind, as clear as light.

In the triangle ABC, the side AB = 4, AC = 3, and BC = 5. The area = AB.AC ÷ 2 = 6. If the area of the inscribed circle be to the area of the triangle as 37 to 75, then the area of this circle is 2·96. But this is impossible, as is evident from the proof below.

Let r = radius of inscribed circle. This radius = the perpendicular dropped from the centre D on any of the sides. Join D to A, B, C. Then the original triangle is divided into three triangles. The area of the triangle DBC = half the product of the radius into the side BC, that of AC half the product of the radius into AC, etc. Call BC, AC, AB a, b, and c respectively.



Then $\triangle DBC = \frac{ra}{2}$;

$$\triangle ADC = \frac{rb}{2};$$

$$\triangle ADB = \frac{rc}{2}.$$

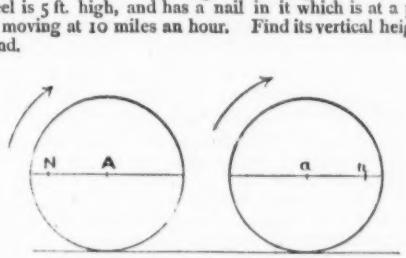
$\therefore$ Area of whole triangle

$$= r \times \left(\frac{a+b+c}{2}\right) = 6r;$$

$$\therefore 6r = 6, \text{ and } r = 1.$$

And since area of circle $= \pi r^2$, area of inscribed circle $= 3{\cdot}14159$, etc.

Ann (*Herne Hill*).—A carriage is moving at 8 miles an hour. The wheel is 5 ft. high, and has a nail in it which is at a particular moment moving at 10 miles an hour. Find its vertical height above the ground.



Let N be the position of nail, and A the centre of the axle of the wheel. After the wheel has made half a revolution, N is now in the position *n*, and A in the position *a*. The point A has been moving horizontally onwards, and since the wheel has made half a turn, it has moved in a straight line which is equal in length to half the circumference of the wheel. The point N has moved onward farther than this, for while in the first position it was behind A, it is now in front of it. The excess of the onward progress of N over that of A therefore equals 2NA. If we take $3\frac{1}{7}$ as the ratio between the circumference of a semicircle and its radius, A has moved onward $3\frac{1}{7}$ times the radius of the wheel, or $2\frac{1}{2}$ ft. $\times 3\frac{1}{7} = 7\frac{6}{7}$ ft. N has moved on $7\frac{6}{7}$ ft. + 2NA. By the terms of the question, the ratio between these is as 8 : 10.

$$\text{Then } \frac{7\frac{6}{7} \text{ ft.}}{7\frac{6}{7} \text{ ft.} + 2\text{NA}} = \frac{8}{10} = \frac{4}{5}.$$

$$\therefore 8\text{NA} + 31\tfrac{3}{7} = 39\tfrac{3}{7} \text{ ft.}$$

$$\therefore 8\text{NA} = 7\tfrac{6}{7} \text{ ft.},$$

$$\text{and NA} = \tfrac{55}{56} \text{ ft.} = 11\tfrac{11}{14} \text{ in.}$$

$\therefore$ Vertical height of the nail when in its highest position
$= 2$ ft. 6 in. $+ 11\frac{11}{14}$ in. $= 3$ ft. $5\frac{11}{14}$ in.

REVIEWS.

Xenophon: Œconomicus. Part I. Text and Notes. J. Thompson and B. J. Hayes. 'University Tutorial Series.' W. B. Clive: University Correspondence College Press.

This volume maintains the standard of previous publications of the series. They are confessedly cram-books for a special examination; in this case for that of Intermediate Arts at the London University in 1896: but they are excellent specimens of the class; and this particular volume is, like the others, as thorough as it can well be. All the matter necessary for the student is given shortly and clearly, so that with the help of the Vocabulary, Test Papers, and Translation promised in the two remaining parts, the assistance of a coach may be fairly dispensed with. At the head of the notes in each chapter, a short *précis* of its contents enables the thread of the argument to be followed without difficulty. Variant readings are given where at all important, and explained. The text seems carefully edited.

Cicero. In Catilinam III. Part I. Text and Notes. A. Waugh Young and W. F. Mason. 'University Tutorial Series.' W. B. Clive.

This is a subject for the Matriculation Examination at the London University in 1896. The introduction contains matter which has already appeared in volumes of this series (Cicero, Ad Atticum IV., and Sallust's Catiline), and includes short sketches of the lives of Cicero and Catiline, and of Roman history up to their time, showing, especially in the latter, the changing fortunes of the Senate and explaining the existence of such extreme democrats as Catiline. The notes are worked up with the minuteness and care usual in this series, with full historical references.

Chaucer—Prologue and Knight's Tale. Edited by A. J. Wyatt, with a Glossary by S. J. Evans. 'University Tutorial Series.' W. B. Clive.

As far as can be seen from a somewhat cursory perusal, this is an excellent help to the beginner in Chaucer. Introduction and notes are clear and pleasantly written; the latter being, as in all the volumes of this series, very full. Disputed points are shortly put and decided as far as possible with sanction of good authorities, quotations from whom are frequent and to the point. Words not explained in the notes are made clear in the glossary; and altogether it is difficult to see how, with this edition in his hand, the student can ever go astray. The text keeps the old spelling as far as possible, but is clear to read.

Via Nova. A new Latin Reader. By W. T. Fyfe. New Edition. MacDougall's Educational Co., Limited.

That this is a fresh edition of the book enlists one at once in its favour. It is certainly a satisfactory graduated course on the excellent lines of retranslation. Each lesson consists of a Latin piece followed by a piece of English which reproduces the Latin words and constructions, but in different sentences, so that scope is given for the exercise of the pupil's intelligence as well as memory. Attached to each lesson is also a short conversation of question and answer on the subject of the Latin piece. This certainly tends to make the language a more interesting and living one than is usually the case in Readers, as well as impressing the words on the memory.

Selections from Phædrus, Books I. and II. Edited, with Notes, Exercises, and Vocabularies, by S. E. Wimbolt. Price 1s. London and Glasgow: Blackie & Son, Limited.

Mr. Wimbolt evidently intends this book for the merest beginners, to judge from his directions for translation, which deal with the very simplest sentences, and from the fact that the word *est* is fully described in the vocabulary of Fable I. as '3rd pers. sing. ind. pres. of *sum, fui, esse*, v.n., I am'; and indeed from his own preface. What necessity, then, is there for an introduction which includes short descriptions of the aims of fable writers in general, and of the difference between a fable and a parable? Why is so difficult a word as 'desiderative' left unexplained? For, from his translation and parsing hints, the editor evidently intends that the master's aid may be dispensed with in using this book. Again, the note on I. 10-12 is 'Notice how pathetic is the lion's noble rage.' Does a small boy beginning translation require such a note as that? On xix. 1, we have a German couplet quoted for comparison with the sentiment of the line. On xxxiii. 1, 'verbis jactans gloriam,' there is the following note: 'Translate *gloriam* as an adject., and *verbis* as object of jactans'; while in the vocabulary attached to the fable the English of *gloriam* is given as 'fame, renown,' that of *jacto* as 'I boast of.' What is the 1st form dunce to make of this? On xxix. 12, *debet*, the note is '*dare* sometimes means "to tell": *da, Tityre, nobis*': an entirely gratuitous and irrelevant remark.

We do not quarrel with Mr. Wimbolt's scholarship or accuracy; moreover the exercises attached by way of illustrating some grammatical point to each fable are a good idea. But he has not the gift of shortness and simplicity, which is needed for beginners. He tries to get too much into them, and the result would probably be confusion in the minds of the boys.

A Method of Teaching Upright Writing in the Infant School.—A Method of Teaching Civil Service Writing in the Infant School. London: T. Nelson & Sons.

These two books are very similar in their purpose and in the matter they contain; the latter, indeed, is almost identical, except for the difference of the illustrative models and the necessary differences in their description. The underlying principles in each case are (1) that Kindergarten drawing should be made the basis of the teaching of writing, (2) that the letters should be carefully analysed into their elements and classified according to the results of the analysis, and (3) that the foundation of the style of writing to be taught to older children should be taught in the Infant School. With these principles we heartily agree, and we think the hints and suggestions given in these books are thoroughly adapted to the working out of the principles we have noted.

Each book contains fifteen full-page plates of diagrams, illustrative of the respective styles of writing, including the simplest elements of the letters and the writing of continuous sentences.

The letters in the upright writing are rather narrower, and the spaces between them rather wider than we like, but the method of teaching them seems thoroughly sound, and we heartily commend the books to the teachers of Infant Schools and the lower standards.

The English Citizen: His Life and Duties. By Charles Henry Wyatt.

The Citizen and the State. Part I.: Representative Government. By E. J. Mathew, B.A., LL.B.—**Part II.: Industrial and Social Life and the Empire.** By J. St. Loe Strachey. London: Macmillan & Co.

Since Mr. Acland introduced into his Education Code for Evening Continuation Schools 'The Life and Duties of a Citizen' as a subject of instruction, many books have been published to assist the students and teachers of this important branch of instruction. Amongst those that have come under our notice we know of none better adapted to fulfil their purpose than the three named above.

The volume by Mr. Wyatt, Clerk of the Manchester School Board, was the first published of the three. It is interesting and full of information, but the opening chapters, which deal somewhat generally with the subject, seem to presuppose considerable acquaintance with the terms used in discussing social and political matters. This is perhaps the result of rather hurried preparation to meet a new requirement, as other tokens of hasty work are also to be found in the later

chapters. The volume is remarkably well illustrated by pictures of important public buildings and other subjects to the number of nearly a hundred, one third of the whole being full-page illustrations.

Mr. Mathew's volume gives an excellent account of the principles of representative government, and traces the historical development and practical working of these principles in the spheres of local and central government. The explanatory parts are very clearly stated, and the historical chapters embrace important lessons on the meaning and use of history. Many politicians of the present day would probably take a rather less favourable view of the value of the hereditary house of Parliament than Mr. Mathew takes in his chapter on the Present Position of the House of Lords.

The volume by Mr. Strachey deals with the facts of industrial and social life in a really masterly way, and so as to afford valuable instruction in morality in concrete form. The lessons of mutual help and practical patriotism are impressed upon the reader's mind by clear exposition and apt illustration. The forms of associated action for good ends in Trades Unions, Co-operative Societies, and Friendly Societies, are described in detail in a fair and useful manner. The way in which a possible dispute in the boot and shoe trade might be dealt with by mutual consideration on the part of the two parties concerned is of great present interest, and might seem almost prophetic.

The latter part of the book gives a broad view of the mutual relations of the various parts of the British Empire.

We must say a word in favour of the excellent illustrations which embellish the book, as well as of the good print and paper and the neat and substantial binding.

For the higher classes in our day schools and for the evening continuation schools these volumes will serve admirably as special readers.

Cambridge Natural Science Manuals: (1) Light, (2) Mechanics. By R. T. Glazebrook, M.A., F.R.S. London: C. J. Clay & Sons.

The older Universities have been reproached, not, unfortunately, without justice, with neglect, partial at least, of natural science. This reproach is becoming daily less and less pointless, for which the Cavendish Laboratory, commemorating at once the generosity of the Duke of Devonshire and the genius of his ancestor, after whom it is named, is in great measure responsible. No individual has done more to make science teaching practical, and therefore real, than Prof. Glazebrook, the presiding genius of Cavendish Physical Laboratory. And these two volumes are a living proof of this, seeing that they approach both Light and Dynamics by way of simple experiments capable of being performed by the students themselves with apparatus not necessarily involving a great outlay. We heartily recommend the books to the notice of all science teachers, and especially to the masters of Organised Science Schools, which will soon have to face the question of simple practical work in physics, for which these books will constitute an admirable introduction if not a complete *vade mecum*.

The New Code and Pocket Diary for 1895-6. London: Messrs. Jarrold & Sons.

This excellent and ingenious little combination of Code, pocket-book, diary, and general factotum to the teacher has reached its 13th year of issue, keeping admirable pace with the times, to the end that to-day, as heretofore, the teacher may readily find all his wants supplied by this 'Enquire within upon everything.' The highest praise that can be awarded the pocket diary is to say that it is up to the high level of excellence attained by its predecessors, which it undoubtedly is.

The School Board Chronicle Edition of the Code for Day Schools, with other information. London: Messrs. Grant & Co.

The Code gets more and more complex year by year, so that not only does the man in the street get entangled in its devious mazes when trying to understand how the Board School is run, but even the School Board clerk and schoolmaster are glad to avail themselves of a *vade-mecum* to the Code and its interpretation. The 'Chronicle' Code is able to solve all doubts, and is alike suitable for both schoolmaster and clerk. In an admirable and exhaustive preface all innovations are clearly described, whilst all the official rulings and circulars, and every other piece of information likely to guide the feet of the dubious, will be found in this well-arranged edition of the Day School Code.

The First Technical College. By A. Humboldt Sexton. London: Chapman & Hall.

Time was when science and technology had no habitation or home in Britain. *Nous avons changé tout cela*, and now institutions sacred to these useful goddesses are as plentiful as gooseberries. To read the history of the pioneer, to note each step in the upward course of one of the most successful technical colleges in the world, when told by a professor and an enthusiast such as Mr. Sexton is known to be, cannot but be interesting. And interesting in sooth have we found it, for the story is well told and just as efficiently illustrated. We can therefore speak highly of the book, which we commend to the notice of all who have any interest in the progress of science and technology in our midst.

Lyrics and Elegiacs. By Marcus S. C. Rickards. London: George Bell & Sons.

The muse of Mr. Rickards is fluent, thoughtful, earnest, and healthy. The subjects of the lyrics are scenes of nature, birds, and flowers, and the feelings inspired by such things in a soul apt to be moved by them, but yet not quite carried away by them. Hence we do not find much evidence of that fire which springs only from the influence of the divine afflatus.

Much of the moralising in the elegiac poems is very impressive. We were particularly struck by the poem called 'Limitations'; and the 'Reverie on Hatherleigh Churchyard' is full of serious thought fitly expressed. Since the subject and treatment have a suggestion of Gray's famous elegy, it is much to have achieved such success. Readers may find the perusal of these poems a pleasant and profitable pastime for a leisure hour or two.

McDougall's Advanced Kindergarten Exercises for the Standards.—McDougall's Kindergarten Cards for Standards I. and III. London: McDougall's Educational Company, Limited.

The new requirements of the Education Code have already stimulated school publishers to produce special helps to teachers who have to begin work on new lines, or, at any rate, to extend work already begun in the infant school to the classes of older children. The little text-book named above gives much practical help in the form of suggestions and plans for teaching such 'suitable occupations' as paper-folding, cutting, design-making, ruling and colouring, cardboard work, mounting and modelling. As the book is stated to be the joint production of the headmaster of a London Board School and a certificated teacher of Kindergarten, we might have expected rather more finish in the style of presenting the hints. There is a remarkably free and easy manner of passing from the first person singular to the first person plural, and we seem to hear the voice of a young teacher in the crude and weak emphasis of such expressions as 'I do think, however,' and 'I must say.'

The packets of cards supply a number of designs in colour suitable for drawing on squared paper, and for crayon work. Teachers are sure to find them useful aids in the work which will shortly become obligatory.

School Marches. Composed by Elementary School Teachers. London: J. Curwen & Sons.

This series of 12 marches will be very welcome in those many schools where assembly and dismissal, as well as the various drills, are enlivened by accompanying musical selections.

The volume marks the growing popularity of music in our primary schools no less than the determination of the

teachers' music caterers—Messrs. Curwen & Sons—to keep pace with the demands springing from this popularity. All lovers of music will wish School Marches a long and prosperous career, which the good quality of the composition seems likely to ensure.

Elementary Practical Chemistry, Inorganic and Organic. By Hewitt and Pope. London: Whittaker & Co.

This cheap little laboratory manual will certainly become popular in practical chemistry circles, for the mark of the practical teacher is evident on every page. After working through the tables herein given it will not be easy for a student to be ploughed in the 'test-tubing' which South Kensington honours by the name of Practical Chemistry.

Object Lessons in Elementary Science, following the scheme issued by the London School Board. By Vincent T. Murché. Part I., Standards I. and II.; Part II., Standards III. and IV.; Part III., Standards V.–VII. London: Macmillan & Co.

Mr. Acland is responsible for many innovations now at work remodelling school procedure in our State-aided schools, and foremost amongst these must be placed the filip that he has so wisely given to object teaching. And the Vice-President, in conjunction with H.M. Inspector and the London Board Scheme of Object Lessons, is responsible for the issue of this work by Mr. Murché. Let us hasten to say that the work is happily conceived and well achieved. Correct information on the common objects to be examined is given in a rational order, so that continuity as well as exactness will be accomplished by the followers of Mr. Marché's scheme. Furthermore, he has set out an outline of the lessons in full in a list of the objects required to carry out the experimental and therefore most important portion of the work successfully. No London School Board teacher can afford to neglect these volumes, and few teachers indeed can read them without drawing therefrom many valuable suggestions for carrying out the work in object teaching now required by the Code.

Professor Meiklejohn's Series.—Word-Building as a Guide to Spelling. Standards IV., V., and VI. London: Alfred M. Holden.

As might fairly be expected, these little books are carefully adapted to their end. In that for Standard IV. over five hundred words of a simple kind in common use are arranged alphabetically, and in connection with each is given a number of other words derived from them by inflection or composition. To this list another is added of pairs of words similar in sound but different in meaning.

For Standards V. and VI. lists of more difficult words are given on the same plan, and sections are also devoted to the rules for word formation, to the use of Latin prefixes, and to lists exhibiting special features of word-formation.

The Practical Series of Varied Occupations for the Lower Standards. Course I., Clay Modelling; Course II., Water Colour Brush Work. By William H. Wilson and William Nelson. London: George Philip & Son.

The authors of this series have planned the courses of instruction in the first place for the benefit of the Manchester Board Schools, in which they are officially interested. The books will be found extremely useful and suggestive to teachers who have to meet the new requirements of the Education Code.

The first volume presents a 'series of thirty designs for clay-modelling, arranged in seven groups of exercises, for Standards I., II., and III.' The designs are printed in lithography so as to show the forms in light and shade. They proceed from simple discs and strips to naturalistic floral forms, and such objects as acorns and pomegranates. An Introduction on Varied Occupations furnishes valuable hints and instructions for the teacher's use.

The second volume sets forth a course of exercises in water-colour brush work in a series of forty plates, based on the drawing requirements for the three lowest standards. Thus set A for Standard I. consists of eighteen designs formed by straight lines on squared paper, and coloured in one, two, three, or four tints. Set B for Standard II. combines curved and straight lines, and the colours are compounded. Set C for Standard III. contains twelve designs of more advanced character both as to form and colouring.

The authors of these works lay claim to 'originality of idea, simplicity, rationality of design, and suitability to the ages and capabilities of the average Standard I., II., or III. child, and the possibilities of the average school.' They have preferred the particular forms of occupation, because of 'their simplicity, their inexpensivenes, the absence of any required tool, their value as factors in the training of hand and eye, and their interconnection with the rest of school work, also as being suitable for both boys and girls in the junior standards, and as offering a sufficiently wide field for a single year's work for each standard.' The greater part of this claim appears to be clearly made out; and we have no hesitation in recommending the volumes to teachers.

Teaching and Teachers. By H. Clay Trumbull, D.D. London: Hodder & Stoughton.

The second title of this book, 'The Sunday School-Teacher's Teaching Work and the Other Work of the Sunday-School Teacher,' indicates the subject more particularly, and we are not left long without clear indications of its American origin. In a number of interesting chapters it sets forth The Teaching Process, its Nature, its Essentials, its Elements, and its Methods in Preparation, in Practice, and in Review.

In a second part the further work of the teacher is defined and illustrated as 'the shaping and guiding of scholars.' Though primarily intended for Sunday-school teachers, the book, which is evidently based on wide experience and written with earnest thoughtfulness, is calculated to afford useful hints to all teachers. The writer possesses a large fund of illustration, and shows much readiness in using it fittingly. The style is rather sententious in many parts, and occasionally errs in excessive repetition and a tendency to become prolix.

Reference is frequently made to the opinions of writers on education, such, for example, as James Gall, Froebel, Dr. Quick. On the subject of questioning as a method of teaching, Dr. Trumbull endeavours to break a lance with our eminent fellow-countryman, Dr. Fitch.

Vere Foster's Drawing Books: S1, S2, X1, X2, X3, Y1, Y2. London: Blackie & Son, Limited.

The latest numbers of the series of Drawing Books edited by Mr. Vere Foster treat of special branches of the art of drawing. The two books bearing the letter S contain a large number of examples in drawing to scale, from the construction of simple scales to complex geometrical patterns and elevations of common objects, including machines. The books marked X include exercises in shaded drawing in three stages—easy, simple, and advanced. Those marked Y form a course of practical architectural drawing, illustrated by a set of examples giving plans, sections, elevations, and details of 'a somewhat ornate cottage house.' Each book contains space for the pupil to make a copy of the drawings given. The whole forms an admirable completion of a well-known and widely-used series of helps to the teaching of drawing.

Blackie's School and Home Library. London: Blackie & Son, Limited.

The good judgment in selecting suitable books, which has already been noticed in speaking of previous instalments of this admirable series of books for the school library, is again conspicuous in respect to the books now under review. Dickens' 'Old Curiosity Shop' (2 vols.), Scott's 'Ivanhoe' (2 vols.), Fenimore Cooper's 'Deerslayer' and 'Pathfinder,' Miss Cummin's 'Lamplighter,' Plutarch's Lives, Michael Scott's 'Tom Cringle's Log,' are undoubtedly popular with our young folks, and sufficiently didactic to satisfy the most exacting in this particular. We have, therefore, once more to express our high opinion of Messrs. Blackie's increasing library for the school and home.

Our Science Section.

MATHEMATICS.

STAGES 2 AND 3, SCIENCE AND ART DEPARTMENT.

BY G. A. BAXANDALL,

Assistant Mathematical Instructor, Royal College of Science, London.

STAGE 3—*continued.*

Ex. 21 (*April*).—Find the coefficient of x in the product $(1+x)(1+2x)^2(1+3x)^3 \ldots\ldots (1+rx)^r$.

The terms in x in these factors have for their coefficients the numbers $1, 2^2, 3^2, 4^2, \ldots r^2$. Hence, since in multiplying factors together, every term in the answer is the result of taking 1 term from each factor, if we wish to get the term in x in the product we must take x from the first factor and 1 from each of the others, then 2^2x from the second and 1 from each of the rest, and so on, the sum being $(1+2^2+3^2+\ldots r^2)x$, the coefficient of which $= \frac{r}{6}(r+1)(2r+1)$. (See Tod., Art. 460, *or* H.K., Art. 68.)

Ex. 22 (*April*). Find the coefficient of x^{2n} in $(1-2x+x^2)(1+x)^{2n}$, and also in $(1-2x+x^2)(1+x^2)^n$, n being a positive integer.

$$(1-2x+x^2)(1+x)^{2n} = (1-2x+x^2)$$
$$(1+2nx+\frac{2n(2n-1)}{1.2}x^2+\ldots Ax^{2n-2}+Bx^{2n-1}+Cx^{2n}).$$

It will be observed that we have chosen three terms in the expansion of $(1+x)^{2n}$, and these are the three which when multiplied by $(1-2x+x^2)$ each produce a term in x^{2n}.

Now $A = {}_{2n}C_{2n-2} = \frac{2n(2n-1)}{1.2}$;

$B = {}_{2n}C_{2n-1} = 2n$;

and $C = 1$;

therefore the required coefficient of x^{2n}

$$= \frac{2n(2n-1)}{1.2} - 2n \times 2 + 1 = 2n^2 - 5n + 1.$$

Again, $(1-2x+x^2)(1+x^2)^n = (1-2x+x^2)$

$$(1+nx^2+\frac{n(n-1)}{1.2}(x^2)^2+\ldots\ldots Ax^{2n-2}+Bx^{2n-1}+Cx^{2n}).$$

Although we have put in Bx^{2n-1}, it does not exist, since $2n-1$ is odd, and in $(1+x^2)^n$ every power of x is even. Hence required coefficient of $x^{2n} = 1 \times C + 1 \times A = 1 + n$, for C and A must be the same as coeffs. of 1st and 2nd terms.

Example.—Show that the coefficients of the middle term in the expansion of $(1+x)^{2n}$ is $\frac{1.3.5\ldots\ldots(2n-1)}{\lfloor n}2^n$.

There are $2n+1$ terms, therefore the middle one is the $(2n+1)^{\text{th}}$, and its coefficient will be ${}_{2n}C_n = \frac{\lfloor 2n}{\lfloor n \lfloor n}$. To show that this is equal to the required expression, consider $\frac{\lfloor 8}{\lfloor 4}$, for this is of the type $\frac{\lfloor 2n}{\lfloor n}$.

Now $\frac{\lfloor 8}{\lfloor 4} = \frac{8.7.6.5.4.3.2.1}{4.3.2.1}$, and cancelling the factors in the denominator into the even numbers in the numerator we get $\frac{\lfloor 8}{\lfloor 4} = 2^4 \times 7.5.3.1$. Similarly,

$\frac{\lfloor 2n}{\lfloor n} = 2^n \times (2n-1)(2n-3)\ldots\ldots 7.5.3.1$, and hence

$\frac{\lfloor 2n}{\lfloor n \lfloor n} = \frac{1.3.5\ldots\ldots 2n-1}{\lfloor n}2^n$. This is a most useful example.

Read Arts. 173, 174, H.K., *or* 513, 514, Tod.

In Art. 517, Tod., and Arts. 177–182, H.K., it is proved that whatever n may be, $(1+x)^n = 1 + nx + \frac{n(n-1)}{1.2}x^2 + \ldots\ldots$, in which the $(r+1)^{\text{th}}$ term is $\frac{n.(n-1)\ldots\ldots(n-r+1)}{\lfloor r}x^r$.

The student must make himself familiar with the following types of examples.

Example.—Get the $(r+1)^{\text{th}}$ terms of $(1-2x)^{-\frac{3}{2}}$.

Copying from above we get—

$$(r+1)^{\text{th}}\text{ term} = \frac{(-\frac{3}{2})(-\frac{3}{2}-1)\ldots\ldots(-\frac{3}{2}-r+1)}{\lfloor r}(-2x)^r,$$

in which there are r factors in the numerator, which, if we simplify and take out (-1) from each, we get

$$(r+1)^{\text{th}}\text{ term} = (-1)^r.\frac{3.5.7\ldots\ldots(2r+1)}{2^r\ \lfloor r}(-1)^r.x^r.2^r$$
$$= (-1)^{2r}.\frac{3.5.7\ldots\ldots(2r+1)}{\lfloor r}x^r,$$

and this is positive, for $2r$ is even.

Example.—Get the $(r+1)^{\text{th}}$ term of $(1+x^2)^{-3}$.

$$(r+1)^{\text{th}}\text{ term} = \frac{(-3)(-3-1)\ldots\ldots(-3-r+1)}{\lfloor r}(x^2)^r$$
$$= (-1)^r.\frac{3.4.5\ldots\ldots r.(r+1)(r+2)}{\lfloor r}x^{2r}.$$

If we complete the factorial in the numerator by multiplying top and bottom by 2, $\lfloor r$ will cancel, and we get $(-1)^r\frac{(r+1)(r+2)}{2}x^{2r}$, which will be positive or negative according as r is even or odd.

To get the *numerically greatest term* in any binomial expansion, write down the $(r+1)^{\text{th}}$ and r^{th} terms in the manner shown above. Then take the ratio of the $(r+1)^{\text{th}}$ to the r^{th} and equate to unity. This gives a value for r, and by adding unity to the integral part of this value of r, the number of the biggest term is obtained.

Thus, find the greatest term in the expansion of

$(1-7x)^{-1\frac{1}{4}}$ when $x = \frac{1}{8}$.

$$(r+1)^{\text{th}} = \frac{-1\frac{1}{4}(-1\frac{1}{4}-1)\ldots\ldots(-1\frac{1}{4}-r+1)}{\lfloor r}(-7x)^r$$
$$= \frac{11.15.19\ldots\ldots(4r+3)(4r+7)}{4^r\ \lfloor r}7^r x^r$$
$$r^{\text{th}} = \frac{11.15.19\ldots\ldots(4r+3)}{4^{r-1}\ \lfloor r-1}7^{r-1}x^{r-1}$$
$$\frac{(r+1)^{\text{th}}}{r^{\text{th}}} = \frac{4r+7}{4r}.7x = (1+\frac{7}{4r}).7x.$$

Now, if r is such that this is bigger than unity, the $(r+1)^{\text{th}}$ is clearly bigger than the r^{th}, but as r gets bigger this expression gets smaller, so that as we go up from term to term we shall sometime arrive at a value of r for which $(1+\frac{7}{4r})7x$ is less than unity, and then the $(r+1)^{\text{th}}$ and terms above, get less. To get the biggest term therefore, we must stop when $(1+\frac{7}{4r})7x = 1$, or $r = 12\frac{1}{4}$. If we had a term number $12\frac{1}{4}$, then this, and the term number $12\frac{1}{4}$, would be bigger than every other; therefore the 13th will really be the biggest.

Read Art. 523, Tod., or Art. 190, H.K. Art. 176, H.K., is useful sometimes.

Let $(1+x)^n = c_0 + c_1x + c_2x^2 + \ldots\ldots c_nx^n$,

then $\left(1+\frac{1}{x}\right)^n = c_0 + \frac{c_1}{x} + \frac{c_2}{x^2} + \ldots\ldots \frac{c_n}{x^n}$.

Imagine the right-hand sides multiplied together. The coefficient of x^2 (and similarly for any other term) would be $c_0c_2 + c_1c_3 + \ldots\ldots c_{n-2}c_n$, which series must also be the coefficient of x^2 in the product $(1+x)^n \times \left(1+\frac{1}{x}\right)^n$ or $\frac{(1+x)^{2n}}{x^n}$, and the coefficient of x^2 in $\frac{(1+x)^{2n}}{x^n}$ is the same as that of x^{n+2} in $(1+x)^{2n}$, *i.e.* $\frac{\lfloor 2n}{\lfloor n+2 \, \lfloor n-2}$. In this way many relations can be found to exist between the coefficients of $(1+x)^n$.

Work the following:—Chap. XXXVI. Tod., Exs. 3, 6, 11, 13, 20, 31, 34, or Exs. XIV.*a*, H.K., Nos. 3, 13, 18, 21, and Exs. XIV.*b*, 9, 11, 13, 33.

24. Write down and simplify the first four terms, and the $(r+1)^{th}$ term of the expansion of $(11-13x)(1-x)^{-2}$. Find the term of lowest dimensions in x which has a negative coefficient, and of the terms with positive coefficients find that one which has the greatest coefficient.

Ans. $11 + 20x + 27x^2 + 32x^3$; $(r+1)(11-r)x^r$; 13th; 6th.

[N.B.—The last two answers are deducible from the second.]

Trigonometry.

Ex. 24 (*April*).—In any triangle if $\tan\frac{A}{2} = \frac{5}{6}$, $\tan\frac{B}{2} = \frac{20}{37}$, find $\tan\frac{C}{2}$, and prove that $a + c = 2b$.

Since A, B, C are angles of a triangle, we have

$$\frac{C}{2} = \left(90 - \frac{A+B}{2}\right),$$

$$\therefore \tan\frac{C}{2} = \cot\frac{A+B}{2} = \frac{1-\tan\frac{A}{2}.\tan\frac{B}{2}}{\tan\frac{A}{2}+\tan\frac{B}{2}} = \frac{2}{5}$$

on making use of the data. Since we wish to prove a relation between a, b, c, put

$$\tan\frac{A}{2} = \sqrt{\frac{(s-b)(s-c)}{s(s-a)}} = \frac{5}{6},$$

$$\tan\frac{B}{2} = \sqrt{\frac{(s-a)(s-c)}{s(s-b)}} = \frac{20}{37},$$

$$\tan\frac{C}{2} = \sqrt{\frac{(s-a)(s-b)}{s(s-c)}} = \frac{2}{5}.$$

Now these we have to make use of, and observing the numbers, we naturally multiply $\tan\frac{A}{2}$ by $\tan\frac{C}{2}$, and get $\frac{s-b}{s} = \frac{1}{3}$, or $\frac{a+c-b}{a+c+b} = \frac{1}{3}$, from which $a + c = 2b$.

Work the following examples:—

25. Show that the area of any triangle, ABC, is equal to $2R^2 \sin A.\sin B.\sin C$, where R is the radius of the circumscribing circle.

26. If A′B′C′ be the triangle obtained by joining the points of contact of the inscribed circle of the triangle ABC, show that its sides are $2r\cos\frac{A}{2}$, $2r\cos\frac{B}{2}$, $2r\cos\frac{C}{2}$, and its angles are complementary to $\frac{A}{2}$, $\frac{B}{2}$, and $\frac{C}{2}$. Also prove that its area is $\frac{rS}{2R}$, where S is the area of ABC, r and R, the radii of the inscribed and circumscribed circles of ABC.

27. In any triangle, ABC, show that

(1) $\frac{b^2-c^2}{a^2}\sin 2A + \frac{c^2-a^2}{b^2}\sin 2B + \frac{a^2-b^2}{c^2}\sin 2C = 0$.

(2) $(a^2-b^2+c^2)\tan B = (a^2+b^2-c^2)\tan C$.

28. If a^2, b^2, and c^2 be in A.P., prove that cot A, cot B, and cot C are in A.P. also.

29. Show that $\operatorname{cosec}\frac{\pi}{2} + \operatorname{cosec}\frac{\pi}{4} + \operatorname{cosec}\frac{\pi}{8} = \operatorname{cotan}\frac{\pi}{16}$, and that $8(\cos^6 A - \sin^6 A) = \cos 6A + 7\cos 2A$.

If $C = 60°$, prove that $\frac{1}{a+c} + \frac{1}{b+c} = \frac{3}{a+b+c}$.

Geometry.

Ex. 10 (*April*)—*Hint.*—Since the lines are at right angles, the middle point of the movable line is at a constant distance (half the fixed line) from the intersection of the fixed lines, hence it moves in a circle. If this be drawn, the required position of the centre of the moving line is easily found.

Ex. 12.—Draw the two circles meeting at A, and draw any line PAQ. From the two centres drop perpendiculars on to PA and AQ, meeting them in D and E. If PA has to be equal to AQ, then we must arrange that DA is equal to AE, which will happen if AF is perpendicular to PQ, where F is the middle point of the line joining the centres of the circles. That this is so, the student should have no difficulty in proving.

Work the following:—

13. Prove that the bisectors of the angles of a quadrilateral figure meet one another consecutively in four points which lie on a circle.

14. If from a fixed point, P, outside a circle, centre C, tangents PA, PB, are drawn, and a third tangent at a variable point T, on the lesser arc AB, meeting PA, PB, in Q and R; then for all positions of T show that the angle QCR is constant.

15. AB is a fixed chord of a fixed circle, AP a variable chord of the same circle; find the locus of the mid point of BP.

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21. Find for what values of c the expression

$$x^4 - 4x^3 + cx^2 + c^2x - 3$$

is divisible by $x-3$, without a remainder. (20)

Divide in the usual manner, and we have—

$$\begin{array}{l} x-3)\ x^4 - 4x^3 + cx^2 + c^2x - 3\ (x^3 - x^2 + (c-3)x \\ \quad x^4 - 3x^3 \\ \quad\quad -x^3 + cx^2 \\ \quad\quad -x^3 + 3x^2 \\ \quad\quad\quad x^2(c-3) + c^2x \\ \quad\quad\quad x^2(c-3) - 3(c-3)x \\ \quad\quad\quad\quad x(c^2+3c-9) - 3 \end{array}$$

For $x-3$ to divide now, $c^2 + 3c - 9$ must $= 1$;

or $c^2 + 3c - 10 = 0$; $\therefore (c+5)(c-2) = 0$; $\therefore c = -5$, or $+2$.

On the other hand, if $x-3$ will divide without remainder, then $x^4 - 4x^3 + cx^2 + c^2x - 3$ should vanish if x is put equal to 3; that is, $3^4 - 4.3^3 + c.3^2 + c^2.3 - 3 = 0$, or $c^2 + 3c - 10 = 0$, the same as before.

22. (*a*) Find every value of x which satisfies the equation :—

$$x^4 - 13x^2 + 36 = 0.$$

(*b*) Find every value of x, with the corresponding value of y, which satisfies the equations :—

$$x^2 - y = 2. \quad y^2 - x = 2. \quad (25)$$

(*a*) $x^4 - 13x^2 + 36 = 0$;

$\therefore (x^2-9)(x^2-4) = 0$;

$\therefore x^2 - 9 = 0$, or $x^2 = 4$, *i.e.*, $x = \pm 3$, or ± 2.

(*b*) $x^2 - y = 2$. (1)

$y^2 - x = 2$. (2)

$\therefore x^2 - y^2 + x - y = 0$; $\therefore (x-y)(x+y+1) = 0$,

from which $x = y$, or $-(y+1)$. Substitute x for y in (1), and we get $x^2 - x - 2 = 0$; $\therefore (x-2)(x+1) = 0$, or $x = 2$, or -1. Now put $-(y+1)$ for x in (2), and we get $y^2 + y - 1 = 0$. Here there are no rational factors, therefore solve in the usual way. Thus—

$$y^2 + y + (\tfrac{1}{2})^2 = 1 + \tfrac{1}{4} = \tfrac{5}{4};$$

$$\therefore y + \frac{1}{2} = \pm\frac{\sqrt{5}}{2}, \text{ or } y = \frac{\pm\sqrt{5}-1}{2}.$$

23. Each of two rectangles has its diagonal 10 feet longer than one of the longer sides of the other rectangle; the area of the first rectangle is $1\frac{1}{2}$ times the area of the second, and a shorter side of the first rectangle is double a shorter side of the second rectangle; find the sides. (25)

Let x, y, be the sides of the first rectangle,

z, z, ,, ,, second rectangle.

Then $\sqrt{x^2+y^2} = v + 10$. (1)

$\sqrt{v^2+z^2} = x + 10$. (2)

$xy = \frac{3}{4}vz$. (3)

$y = 2z$. (4)

By using (4), (3) becomes $x = \frac{7}{8}v$, and (1) now becomes $\sqrt{x^2+4z^2} = \frac{8x}{7} + 10$ by using (3) and (4).

Also $\sqrt{\left(\frac{8x}{7}\right)^2 + z^2} = x + 10$.

Square each side of the last two equations, and we get

$$x^2 + 4z^2 = \left(\frac{8x}{7}\right)^2 + \frac{160}{7}x + 100.$$

$$\left(\frac{8x}{7}\right) + z^2 = x^2 + 20x + 100, \text{ and add.}$$

Thus $5z^2 = x\left(\frac{160}{7} + 20\right) + 200,$

$$z^2 = x\left(\frac{60}{7}\right) + 40.$$

Substitute in (2)

$$\sqrt{\left(\frac{8x}{7}\right)^2 + \frac{60}{7}x + 40} = x + 10, \text{ and square,}$$

$$\frac{64}{49}x^2 + \frac{60}{7}x + 40 = x^2 + 20x + 100, \text{ which gives}$$

$$3x^2 - 112x = 588.$$

$$x^2 - \frac{112}{3}x + \left(\frac{56}{3}\right)^2 = \frac{588}{3} + \frac{3136}{9} = \frac{4900}{9}.$$

$$\therefore x - \frac{56}{3} = \pm\frac{70}{3}; \ \therefore x = 42, \text{ or } -\frac{14}{3}.$$

Since $z^2 = \frac{60}{7}x + 40 = 360 + 40 = 400;$

$$\therefore z = 20, \text{ and } \therefore y = 40, \text{ and } v = \frac{8x}{7} = 48.$$

24. (*a*) If $a + \sqrt{c} = b + \sqrt{d}$, where a and b are rational, and $\sqrt{c}$ and $\sqrt{d}$ are irrational, show that $a = b$, and $c = d$.

(*b*) Reduce the following expression to the form $a + \sqrt{b}$:—

$$\frac{44}{3-\sqrt{5}} + \frac{44}{3+2\sqrt{5}}. \quad (20)$$

(*a*) $a + \sqrt{c} = b + \sqrt{d}$; $\therefore a - b = \sqrt{d} - \sqrt{c}$.

Now we cannot possibly have one side rational, and the other irrational, therefore each side *must* equal zero, that is $a = b$, *and* $c = d$.

$$\frac{44}{3-\sqrt{5}} + \frac{44}{3+2\sqrt{5}} = 44\left[\frac{1}{3-\sqrt{5}} + \frac{1}{3+2\sqrt{5}}\right]$$

$$= 44\left[\frac{3+2\sqrt{5}+3-\sqrt{5}}{(3-\sqrt{5})(3+2\sqrt{5})}\right] = 44\left(\frac{6+\sqrt{5}}{3\sqrt{5}-1}\right)$$

$$= 44\,\frac{(6+\sqrt{5})(3\sqrt{5}+1)}{(3\sqrt{5}-1)(3\sqrt{5}+1)} = \frac{(21+19\sqrt{5})\,44}{44}$$

$$= 21 + 19\sqrt{5},$$

which, if written as $21 + \sqrt{1805}$, is of the form $a + \sqrt{b}$.

25. (*a*) Define ratio. Does it follow from your definition that it would be wrong to speak of the ratio of 5 tons to 3 miles, and, if so, how does it follow?

(*b*) For what values of x will the ratio of $x^2 - 7x + 2$ to $x^2 - 8x + 10$ be equal to the ratio of 2 to 3? Verify your results by substitution. (20)

(*a*) Ratio means the relation which one quantity bears to another of the *same* kind. Since 5 tons and 3 miles are not of the same kind, it would be wrong to speak of the ratio of these quantities.

(*b*) $\frac{x^2-7x+2}{x^2-8x+10} = \frac{2}{3}$; $\therefore 3x^2 - 21x + 6 = 2x^2 - 16x + 20.$

$\therefore x^2 - 5x - 14 = 0$, or $(x-7)(x+2) = 0$; $\therefore x = 7$, or -2.

26. (*a*) Define a mean proportional.

(*b*) If $a : b :: c : d$, show that $\sqrt{abcd}.\{a^2 - b^2 - c^2 + d^2\}$ is a mean proportional to $(ac - bd)^2$ and $(ab - cd)^2$. (20)

(*a*) The mean proportional to a and c is b, such that $a : b :: b : c$, or $b = \sqrt{ac}$.

(*b*) Let $\frac{a}{b} = \frac{c}{d} = k$; $\therefore a = bk$, $c = dk$.

$$\sqrt{abcd}\{a^2 - b^2 - c^2 + d^2\} = \sqrt{bk.b.dk.d}\{b^2k^2 - b^2 - d^2k^2 + d^2\}$$
$$= bdk\{b^2(k^2-1) - d^2(k^2-1)\}$$
$$= bdk(k^2-1)(b^2-d^2).$$

A mean proportional to $(ac - bd)^2$ and $(ab - cd)^2$
$= (ac - bd)(ab - cd) = (bdk^2 - bd)(b^2k - d^2k)$
$= bd(k^2-1)k(b^2-d^2)$.—Q.E.D.

(To be continued.)

ORGANIC CHEMISTRY NOTES.

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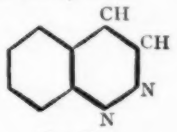
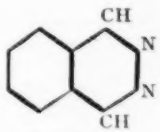
BESIDES the various closed ring compounds, derivatives of pyridine and quinoline, which we have hitherto considered, other substances are known in which more than one CH group of a benzene or naphthalene nucleus has been replaced by an N atom. The compounds in which two atoms of carbon have been replaced by nitrogen are known as diazines, and according to the position of these nitrogen atoms in the ring are known as ortho-, meta-, or para-diazines, terms which are frequently contracted to oiazine, miazine, and piazine.

The ortho-diazines are chiefly known in the analogues of naphthalene, derivatives of the two possible forms having been prepared. The formulæ of the parent substances and the names they are commonly known by are :

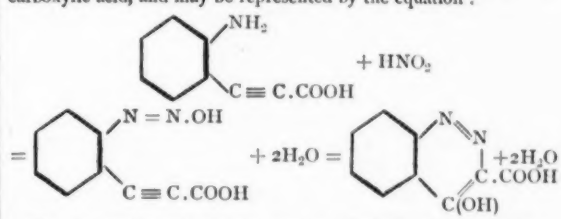


Cinnoline.



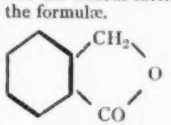
Phthalazine.

Derivatives of the first of these substances were first prepared by V. von Richter in 1883 (*Ber.* 16. 677); he reduced ortho-nitrophenylpropiolic acid to the corresponding amido compound, and then subjected this to the process of diazotisation; the reaction was taken up several years later by Max Busch (*Ber.* 25. 2847). The reaction which occurs between the nitrous acid and the amido-phenyl-propiolic acid results in the formation of an oxycinnoline-carboxylic acid, and may be represented by the equation :

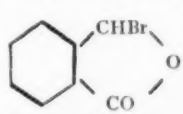


The carboxylic acid can be readily deprived of CO_2 and converted into the oxycinnoline itself. By distillation with zinc dust both von Richter and Busch obtained oily products which could not be satisfactorily worked up; the latter chemist consequently tried wet methods of reduction, such as zinc dust and acetic acid, sodium in alcohol, etc., but with equally fruitless results. In consequence of this he contented himself with the conversion of the substance into other derivatives; thus phosphorus pentachloride gave a chlorcinnoline, $C_8H_5ClN_2$, which yields salts with acids, and is converted by aniline into an anilido-cinnoline, $C_8H_5(NHC_6H_5)N_2$.

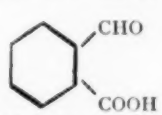
The substance phthalazine, isomeric with the hypothetical cinnoline, has been isolated, and its derivatives studied by Gabriel and his pupils (*Ber.* 26. 521, 2210). In order to prepare the so-called phthalazone, $C_8H_6N_2O$, phthalaldehydic acid was prepared according to the method given by Racine, which consists in the conversion of phthalide into its α-brom-derivative and decomposition with soda solution. Without any isolation of the free acid, a solution containing hydrazine hydrate was added, whereupon the phthalazone separated as a precipitate, which when crystallised forms long glassy needles, soluble in alkalies and strong mineral acids, melting at 182° and boiling at 337°. The relation of phthalide to phthalazone and the various intermediate products is at once rendered clear by the formulæ.



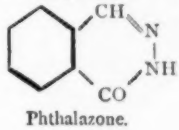
Phthalide.



α-Brom-phthalide.

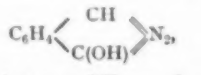


Phthalaldehydic acid.

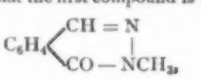


Phthalazone.

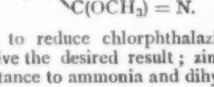
Methylation of the phthalazone results in the formation of a methyl derivative, $C_8H_5ON_2CH_3$, in which the methyl is apparently attached to a nitrogen atom, the H atom of the NH group in the above formula having been replaced by a methyl group; the melting point of the compound is at 102°–103°. Towards phosphorus oxychloride, phthalazone behaves as if it had a tautomeric formula.



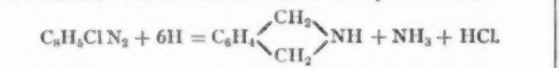
for under these circumstances an OH group is replaced by chlorine, chlorphthalazine resulting. Chlorphthalazine reacts with sodium methylate, the chlorine atom being replaced by OCH_3; and the compound so formed, although possessing the same percentage composition as the substance formed by direct methylation of phthalazone, nevertheless differs from it, forming small needles melting at 60°–61°. We thus see that the first compound is methyl-phthalazone,



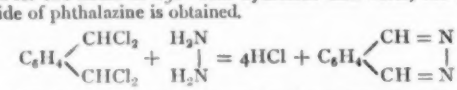
the second however, methoxy-phthalazine,



Gabriel's attempts to reduce chlorphthalazine to the parent phthalazine did not give the desired result; zinc and hydrochloric acid reduced the substance to ammonia and dihydroisoindol.



The desired phthalazine was, however, isolated by the use of Hjelt's ω_2-tetrachlor-o-xylene, $C_6H_4(CHCl_2)_2$. This substance can be prepared by passing chlorine into boiling orthoxylene, and if heated for two hours at 150° with hydrazine and water, the hydrochloride of phthalazine is obtained.



A rather better yield was obtained by first converting the tetrachlorxylene into phthalaldehyde by boiling with water and condensing this with hydrazine hydrate.

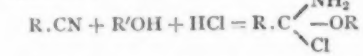
$$C_6H_4(CHO)_2 + N_2H_4 = C_8H_6N_2 + 2H_2O.$$

Phthalazine forms pale-yellow needles which melt at 90°–91°, and boil at 315°–317° with partial decomposition; it is basic and forms well defined salts: on reduction with zinc and hydrochloric acid the hydrochloride of xylylene-diamine, $C_6H_4(NH_2)_2.2HCl.\frac{1}{2}H_2O$ is obtained.

The metadiazines are widely represented; we owe a considerable amount of our knowledge to the researches of Pinner, who prepared his pyrimidines from the amidines. As the amides of the acids may be looked on as acids in which hydroxyl has been replaced by an amido group, or tautomerically where oxygen has been replaced by an imido group; so the amidines are to be looked on as acids in which both these replacements have taken place; we can express the compounds in question according to these formulae :—

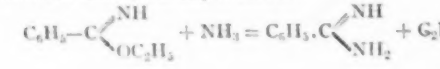
$R.CONH_2$	$R.C(NH).OH$	$R.C(NH)NH_2$.
Tautomeric forms of amides.		Amidine.

Various methods have been employed for the preparation of amidines; but Pinner found that a convenient way was to first prepare an imido-ether and to heat this with ammonia. The imido-ethers are prepared by passing hydrogen chloride gas into a mixture of the nitril of an acid and an alcohol; the reactions which take place in the case of different nitriles and alcohols can be represented by general equations as follows :—



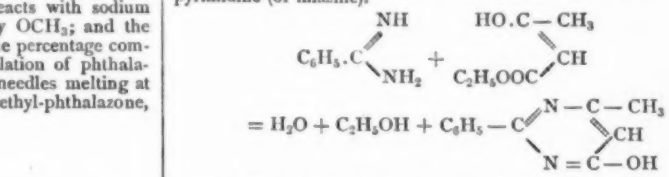
These intermediate compounds are very unstable, readily lose HCl, and give the imido ethers.

The formation of benzamidine from ethyl imidobenzoate by the action of ammonia is easy to follow.



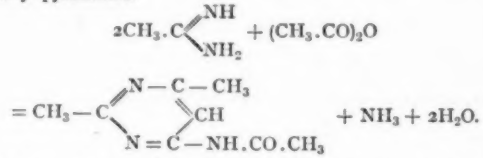
Another method of formation has been more recently given by Tafel and Enoch. By addition of an alkali to a solution of equivalent quantities of silver nitrate and benzamide in hot water, a precipitate of silver benzamide is obtained; this, from the fact that it gives ethyl imido-benzoate and not benzethyl amide on treatment with ethyl iodide, renders it probable that the compound in question is silver benzoate in which an oxygen atom has been replaced by an imido group, and not a silver derivative of benzamide in which the silver atom is linked to nitrogen.

Pinner treated benzamidine with acetoacetic ether, and under splitting off of water and alcohol obtained a phenyl-methyl-hydroxy-pyrimidine (or miazine).



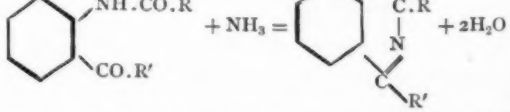
The hydroxyl group in this compound can be replaced by chlorine on treatment with phosphorus pentachloride; and the phenyl-methyl-chlor-pyrimidine so obtained may be converted into an ethoxy derivative by treatment with sodium alcoholate. Finally the ethoxy group can be replaced by amidogen by treatment with ammonia, and phenyl-methyl-amidopyrimidine is produced.

Another method of formation of amido-pyrimidine compounds depends on the action of acetic anhydride on the amidines; thus acetamidine may be converted by this treatment into acetylamido-dimethyl pyrimidine.



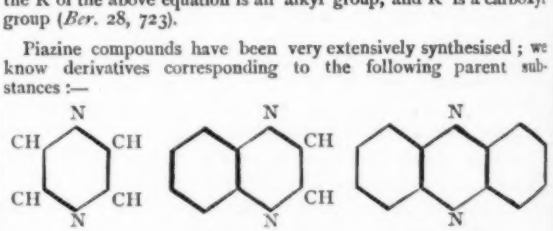
If the acetyl group is removed from this compound, it is found that the resulting amido-dimethyl pyrimidine is identical with the cyanmethine obtained by Baeyer by the polymerising action of sodium on three molecules of methyl cyanide.

Numerous phenmiazine derivatives are now being prepared by Bischler, who condenses the acid derivatives of ortho-amido-benzoyl compounds with ammonia, the reactions taking place according to the equation :—



Thus acetyl amido-benzaldehyd gives methyl phenmiazine if treated in this way. The reaction has been very extensively studied, and Bischler is now examining the action of ammonia on the acid substituted amido-benzoyl-benzoic acids, *i.e.*, compounds in which the R of the above equation is an alkyl group, and R′ is a carboxyl group (*Ber.* 28, 723).

Piazine compounds have been very extensively synthesised; we know derivatives corresponding to the following parent substances :—



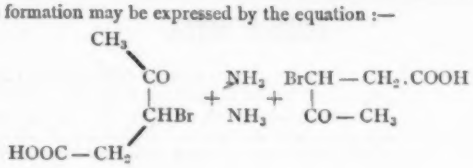
Piazine. Quinoxaline. Phenazine.

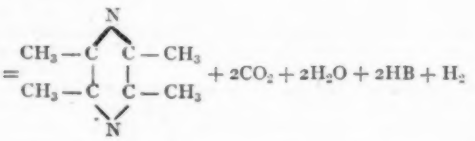
Derivatives of the first of these substances were first prepared by Victor Meyer; when iso-nitroso-acetone is reduced a dimethyl piazine (or ketine) is formed.

$$2CH_3.CO.CH = NOH + 6H = (CH_3)_2C_4H_2N_2 + 4H_2O.$$

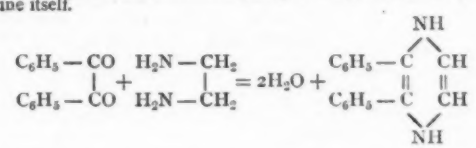
Wolff obtained a compound, $C_8H_{12}N_2$, by the action of ammonia on β-bromlevulinic acid, which from the fact that it yields a tetracarboxylic acid on oxidation by permanganate appears to be tetramethyl piazine, $C_4N_2(CH_3)_4$.

Its formation may be expressed by the equation :—





Numerous synthesis of piazines and derivatives of the dihydro-piazine, $C_4H_4(NH)_2$, have been published by Mason (*Jour. Chem. Soc.*, 1889, 97; 1893, 1284, 1293, 1355). The general method employed was the reaction between ethylene-diamine and allied substances with diketones of the general form, R — CO — CO — R. Thus ethylene-diamine and benzil give a diphenyl-dihydro-piazine, which readily loses two atoms of hydrogen, and passes into diphenyl-piazine itself.



The reaction between phenacyl bromide, $C_6H_5.CO:CH_2Br$, and benzylamine was also studied, mono- and di-phenacyl-benzylamines being obtained. When mono-phenacyl-benzylamine hydrobromide is heated with concentrated soda, 1 : 4—dibenzyl-2 : 5—diphenyl-piazine dihydride is formed according to the equation :—

$$2C_6H_5.CO.CH_2.NH.C_7H_7.HBr + 2NaOH = 2NaBr + 4H_2O$$

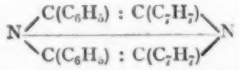
$$+ C_7H_7.N\begin{matrix}CH : C(C_6H_5)\\ C(C_6H_5) : CH\end{matrix}N.C_7H_7$$

Diphenacyl-benzylamine, which reacts as if it had a tautomeric formula, $(C_6H_5.C(OH) : CH)_2N.C_7H_7$, condenses with ammonia or primary amines, *e.g.*, benzylamine, giving dihydro-piazine derivatives.

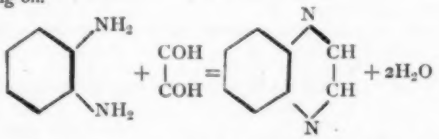
$$C_7H_7.N(CH : C(OH).C_6H_5)_2 + H_2N.C_7H_7 = 2H_2O$$

$$+ C_7H_7.N\begin{matrix}CH : C(C_6H_5)\\ CH : C(C_6H_5)\end{matrix}N.C_7H_7$$

This compound when heated with concentrated hydrochloric acid to 170° loses two atoms of hydrogen, the benzyl groups attaching themselves to carbon. Mason formulates the resulting substance as—

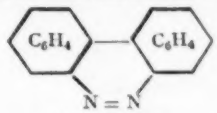


The quinoxalines were discovered and studied by Hinsberg; they may be prepared by the action of glyoxal and other substances containing the — CO — CO — grouping on ortho-diamido-benzene and its analogues. Glyoxaline itself can be prepared by the reaction of ortho-phenylene-diamine with glyoxal, two molecules of water splitting off.



If benzil, $C_6H_5.CO.CO.C_6H_5$, is employed, a diphenyl-quinoxaline results, whilst with pyruvic acid, $CH_3.CO.COOH$, a methyl-oxy-quinoxaline can be obtained.

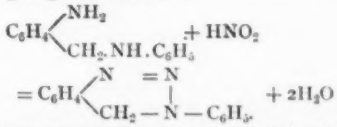
The phenazine derivatives are especially numerous, many of them being valuable dyestuffs. The parent substance, $C_{12}H_8N_2$, was first prepared by Claus who obtained it by heating calcium meta or para-azo-benzoate with calcium hydroxide; it was also formed by Schichutzky by leading the vapour of aniline over red-hot lead oxide. Claus looked on the substance as constituted analogously to phenanthrene, and gave it the name and formula—



Azophenylene.

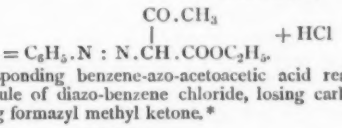
A homologue of this substance was prepared by Merz by the action of mp-tolulylene-diamine, or pyrocatechin; the latter must, therefore, be an azine derivative. For a very good account of the azines the student is referred to Professor Witt's article in Thorpe's 'Dictionary of Applied Chemistry.' True phenazone derivatives have been recently obtained by partial reduction of the diortho nitro-diphenyl compounds.

Triazines are of three types; the three nitrogen atoms may be consecutively, asymmetrically, or symmetrically arranged in the ring. As examples of the first of these, the compounds prepared by Max Busch (*Ber.* 25. 445) may be taken as examples; thus β-phenophenyl-dihydro-triazine can be prepared by dissolving ortho-amidobenzyl aniline in a slight excess of dilute hydrochloric acid, and then adding sodium nitrite, the nitrous acid acting on the diamido substance, and giving the desired base.

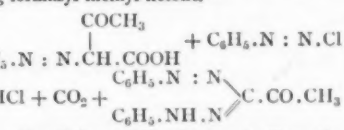


A corresponding compound was also prepared, in which paratolyl group takes the place of the phenyl. These compounds are weak bases, the salts only being stable in acid solution.

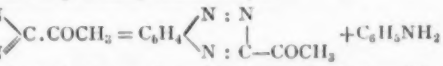
Bamberger has produced derivatives of unsymmetrical phentriazines from the formazyl compounds (see *Ber.* 25, pp. 3547, 3539). A solution of diazo-benzene chloride reacts with acetoacetic ether, giving an azo compound.



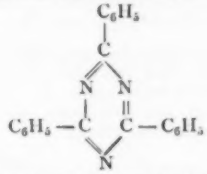
The corresponding benzene-azo-acetoacetic acid reacts with a further molecule of diazo-benzene chloride, losing carbon dioxide and producing formazyl methyl ketone.*



Aniline is split off from this substance by the action of mineral acids and β-phentriazyl α-methyl ketone results.

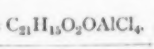


The symmetrical triazines are formed by the polymerisation of the organic cyanides, especially by the addition of an acid chloride and aluminium chloride, though sodium also works the change. If, for example, benzonitrile, *i.e.*, phenylcyanide, be subjected to this treatment, the so-called cyaphenine is produced, a substance which may be represented by the constitutional formula :—



The mechanism of this reaction was studied by Eitner and Krafft in 1892; they obtained an intermediate compound according to the equation—

$$2C_6H_5.CN + C_6H_5.COCl + AlCl_3 = C_{21}H_{15}O_2OAlCl_4.$$

* The name formazyl is given to the group 

This substance will react with ammonia (as ammonium chloride), giving cyaphenine in a yield of 60 per cent. of the theoretically obtainable. The authors (*Ber.* 25. 2263) represent the change by the equation—

$$C_6H_5.C\begin{matrix}=N=C(C_6H_5)Cl[AlCl_3]\\ -N-C(C_6H_5)O\end{matrix} + NH_3$$

$$= [AlCl_3] + HCl + H_2O + C_6H_5.C\begin{matrix}=N=C(C_6H_5)-\\ -N-C(C_6H_5)=\end{matrix}N$$

Disubstituted dihydro-tetrazines were prepared a few years back by Ruhemann, and described in various papers in the *Journal of the Chemical Society*; he attempted to prepare the isocyanides corresponding to the aromatic hydrazines by acting on them with chloroform and alcoholic potash; *e.g.*, in the case of phenyl-hydrazine,

$$C_6H_5.NH.NH_2 + CHCl_3 + 3KOH = C_6H_5.NH.N:C + 3KCl + 3H_2O.$$

It was found, however, that two molecules of the resulting compound condense, giving a diphenyl-dihydro-tetrazine :—

$$2C_6H_5.NH.N:C = C_6H_5.N\begin{matrix}=N=CH-\\ -CH=N-\end{matrix}N.C_6H_5.$$

This reaction was tried in the case of other hydrazines, and found to be general.

Recently Pinner (*Ber.* 27. 984) has described an isomeric diphenyl-dihydro-tetrazine, and as in his compound the phenyl groups are attached to the carbon atoms, the compound may be converted into diphenyl-tetrazine itself. Ethyl imido-benzoate is Pinner's starting-point, and he allows this to react with hydrazine hydrate, benzenyl-hydrazidine resulting.

$$C_6H_5.C\begin{matrix}=NH\\ -OC_2H_5\end{matrix} + NH_2.NH_2 = C_6H_5.C\begin{matrix}=NH\\ -NH.NH_2\end{matrix} + C_2H_5OH$$

This compound reacts readily with another molecule of the imido ether, giving dibenzenyl-hydrazidine.

$$C_6H_5.C\begin{matrix}=NH\\ -NH.NH_2\end{matrix} + \begin{matrix}HN\\ C_2H_5O\end{matrix}\!\!>\!C.C_6H_5$$

$$= C_6H_5.C\begin{matrix}=NH\quad HN\\ -NH-HN\end{matrix}\!\!>\!C.C_6H_5 + C_2H_5OH$$

On warming this substance with hydrazine, the diphenyl-dihydro-tetrazine is obtained according to the equation—

$$C_6H_5.C\begin{matrix}=NH\quad NH\\ -NH-NH\end{matrix}\!\!>\!C.C_6H_5 + H_2N.NH_2$$

$$= C_6H_5.C\begin{matrix}=N-N\\ -NH.NH\end{matrix}\!\!>\!C.C_6H_5$$

Lastly, this substance is easily oxidised by the air, giving the red diphenyl-tetrazine—

$$C_6H_5.C\begin{matrix}=N-N\\ -N=N\end{matrix}\!\!>\!C.C_6H_5$$

Questions—Advanced.—1. Show by equations the method by which succinic acid may be synthetically prepared. 2. How would you determine the presence of hydroxyl, carbonyl, and carboxyl groups in an organic compound? 3. Four tartaric acids are known, how may these be accounted for? 4. How is phthalic acid prepared, and how is it employed commercially?

Honours.—1. Two benzaldoxims and three benzildioxims are known, how have these facts been explained by Hantzsch and Werner? 2. How may the tartaric acids be synthetically prepared? 3. Illustrate the theory of tautomerism by reference to the acid amides, and give the methods by which substances of the general formulæ

$$K.CO.NR'H \text{ and } R.C\begin{matrix}=OR'\\ -NH\end{matrix}$$

may be obtained. 4. Give some account of the synthetical production of closed rings, the members of which are 4 carbon and 2 nitrogen atoms.

SCIENCE NOTES.

THE ROYAL SOCIETY'S CONVERSAZIONE.—This annual event, which is usually signalised by the exhibition of the chief scientific novelties of the year, took place on the 1st May. The company, as usual, was very large, and included most of the leaders of scientific thought. The exhibits were numerous and varied, and were representative of all the sciences. As in many past years, there was a great display of apparatus for various purposes in physics and their application. In this direction the application of electricity to the production of heat was well illustrated by Mr. R. E. Crompton, who showed many means of utilising the current for domestic and manufacturing purposes. The current is conducted by wires made of various alloys, with very high resistances, and these are protected very completely by an insulating enamel, which guards against a loss of heat in the process of conduction. Mr. Crompton showed an electric oven, which was heated on all sides, and on the top and the bottom, and the temperature of which could be regulated by varying the strength of the current. Other forms of electric apparatus were shown by Professor Fleming, Mr. Hicks, and Major Holden. Major Cardew brought to the meeting specimens of the deposit or incrustation on the insulators of the electric light mains at St. Pancras, which has been found to contain metallic sodium and potassium. The deposit was found to have been caused by the passage of alkaline salts in solution to the negative main, the salts being chiefly derived from the neighbouring soil with which the end fibres of the wood bearers were in contact. Electrolysis of these salts took place with liberation of the metals at the negative main, the metals being oxidised and slowly carbonated in air. During this process nodules of the metals seem to have become embedded in the oxides, and preserved from oxidation.

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Biology was represented by fewer exhibits than usual. Some, however, were of considerable interest. An electric eel, *Malepterurus electricus*, from the River Senegal, was shown by Prof. Gotch and Dr. Forbes. This is a small fish, not unlike the slimy cat-fishes, but with half-a-dozen barbs on the side of the head. Dissections of a specimen of this eel were displayed, so prepared as to exhibit the electric apparatus with which it is furnished. The living specimen was made to administer electric shocks to the visitors who cared to test its power, by being lifted out of its globe in a muslin net which had wires attached to it. Another interesting exhibit in this section was that of Mr. W. T. Burgess, showing how bacterial infections can be transmitted by the ordinary house-fly. Cultures of particular bacteria on slices of potato showed where a fly, infected previously with the same bacteria, had walked across them.

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Another discovery of some importance, both to botanists and zoologists, was brought forward in the exhibit of the Marine Biological Association. It has long been a source of annoyance to workers in Natural History that no known preservative fluid will keep intact the natural colours of the specimens immersed in it. The Association exhibited several marine organisms of various colours, which were preserved in a dilute solution of formic aldehyde. They had been immersed in it for some months, and their natural appearance had not suffered.

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The latest chemical individuality, *Argon*, was the source of much interest to most present. Professor Ramsay had a room devoted to the exhibition of its spectrum, and to the spectrum of argon mixed with helion, recently obtained by him from the Norwegian mineral *cléveite*.

***

Mr. W. N. Shaw was the chief exhibitor of apparatus connected with meteorology. He showed by judicious experiments the process of cloud-formation. He had four glass globes in which he illustrated phenomena associated with this process. In the first globe clouds were formed by mixture of two currents of air of different temperatures, the currents being due to convection. The motion of the clouds gave an indication of the motion of the air. The second globe was arranged to show the formation of a cloud by the dynamical cooling of air, consequent upon a sudden expansion equivalent to an elevation of about 10,000 feet. The water globules under these conditions were visible, slowly falling. The third and fourth globes were used in conjunction to demonstrate the modification which cloud-formation introduces into the dynamical cooling of air. In one of the pair condensation was made to diminish the fall of temperature incidental to sudden expansion, and the difference was indicated by the final pressure-difference between the globes.

***

Astronomy came in for a share of attention, but the exhibits were not numerous. Mr. Norman Lockyer showed a photographic

spectrum of α Orionis, which is the first of the kind ever taken. The photograph was taken with a six-inch telescope and an objective prism of 45° and was enlarged twelve times. Mr. Sidney Waters contributed some charts showing the distribution of the nebulæ and star-clusters and their relation to the Milky Way. Upon the charts were recorded the position of the 7,840 objects of the new general catalogue of 1888; the resoluble and irresoluble nebulæ were shown to be most densely scattered in the poles of the galactic circle and avoid the track of the Milky Way, while the star-clusters follow its course with great fidelity. The evidence afforded by this distribution seems to point to some general connection between the nebular system and the system of the stars.

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Other objects of much interest to the general visitor, though perhaps of less scientific importance, were numerous. Among them may be mentioned exhibits of the six metals of the platinum group, shown by Messrs. Johnson, Matthey and Co. Two of them were curiosities: one a platinum nugget of 158 oz. and another a palladium ingot of 1,000 oz., the largest of their kind yet produced. The nugget came from the Ural Mountains. There were besides these, specimens of Rhodium in the form of an ingot weighing 72 oz.; of Osmium, melted and sponge; of Ruthenium, melted by the high temperature of the electric arc; and a sheet of rolled Iridium, pure. There was also shown a very fine collection of beetles, made by Mr. D. Sharp, to illustrate the variation in size of the individuals of the same species.

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Mr. Francis Galton's celebrated 'Finger-print' system of identification also attracted considerable attention. Mr. Galton exhibited several enlarged finger-prints with descriptive notation, illustrating the foundation of the finger-print method lately adopted in the police department for ascertaining whether an unknown and suspected person is an habitual criminal, and for verifying doubtful identity. He also exhibited a print of the hand of a child less than three months old, which showed that even at that early age the ridges of the skin of the finger are distinctly developed.

***

The lectures were delivered by Prof. A. C. Haddon and Lord Armstrong. The former dealt with the Ethnography of British New Guinea, illustrating the physical characters of different tribes and their occupations, relaxations, etc. Lord Armstrong showed on the screen a number of figures representing the results of recent experiments on the electric discharge in air.

CHEMISTRY NOTES.

BY W. TATE, A.R.C.S., F.C.S.

GENERAL NOTES.—*Helium:* Since our last issue much work has been done in connection with this most interesting substance. Prof. Ramsay now believes that the gas obtained from a felspathic rock containing clèveite, and described in a preliminary note as argon together with helium, really consists of helium, nitrogen, and hydrogen. The density of helium when nearly free from nitrogen was found to be 3·89. From the wave-length of sound in the gas, it is concluded that the ratio of the specific heat at constant pressure to the specific heat at constant volume is 1·66 approximately. Hence helium, like argon, may be monatomic (see PRACTICAL TEACHER, p. 498, March 1895). In this case the atomic weight of helium would be near 8. Evidence has been brought forward to show that the gas obtained is not a hydrogen compound. The helium spectrum shows four very characteristic lines absent from the spectrum of argon. Only one of the bright red pair of characteristic argon lines was to be seen in the spectrum obtained with the purest specimen of helium gas. These spectroscopic indications point to the possibility of helium and atmospheric argon having some common constituent.

The conclusion that the gas obtained from clèveite is essentially helium is supported by the evidence of Prof. Clève and Thalén, who found that the argon lines were entirely absent from the spectrum they obtained with gas prepared from clèveite.

The gases obtainable from minerals containing uranium have been very exhaustively examined by Prof. Lockyer and his assistants. He uses a wonderfully simple method of obtaining the gases, simply heating the mineral in vacuo. By a comparison of the photographs of spectra obtained with the evolved gases with similar spectrum photographs of the sun's chromosphere and several of the fixed stars, Prof. Lockyer is able to forecast the probable discovery of many new elements. In the current number (May 16th) of *Nature*, he says: 'We appear to be in presence of the *vera causa*, not of two or three, but of many of the lines which, so far, have been classed as unknown by students both of solar and stellar chemistry; and if this be confirmed, we are evidently in the presence of a new order of gases of the highest importance to celestial chemistry, though perhaps they may be of small practical value to chemists, because their compounds and associated elements are, for the most part, hidden deep in the earth's interior.'

In this connection it may be mentioned that Nordenskiold announces the discovery of an extensive mineral deposit containing uranium, which may become an important source of the new elements.

New Nitroxygen Compounds: Nitro-copper, Cu_2NO_3, is produced by the action of nitrogen peroxide on reduced copper at the ordinary temperature.

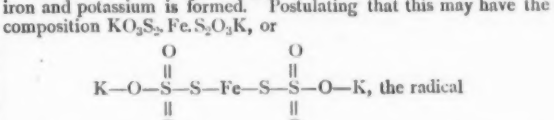
The maroon-coloured product reacts violently with water, and evolves pure nitric oxide with the simultaneous formation of cupric nitrate, cupric nitrite, and metallic copper. The action of heat in an atmosphere of pure dry nitrogen results in the evolution of nitrogen peroxide, partially oxidized copper remaining.

Nitro-cobalt, a black substance of the composition Co_2NO_2, is produced by the passage of a current of nitrogen peroxide mixed with much nitrogen over reduced cobalt. It has similar properties to the copper compound.

It has long been known that nitric oxide, NO, is readily absorbed by a solution of a ferrous salt. Peligot found that ferrous chloride solution dissolved enough nitric oxide to produce the compound $2FeCl_2.NO$. This solution was very unstable, and readily gave off the whole of the dissolved gas on heating. Lately, V. Thomas has obtained crystals of a very stable compound, having the composition $FeCl_2.NO.2H_2O$ (Bull. Soc. Chim.). The substance was obtained by saturating a solution of ferric chloride in ether with nitric oxide, and evaporating the resulting solution at the ordinary temperature in a vacuum desiccator. Smaller yellow crystals of the anhydrous compound, $FeCl_2.NO$, are obtained if the evaporation is carried out at 60° C. The new crystalline substance dissolves completely in water, forming a pale yellow solution, and does not evolve gas, as might perhaps be expected from Peligot's experiments. The solid compound is quite stable in vacuo at the ordinary temperature.

A peculiar series of nitroso-compounds, salts of the acid $Fe(NO)_2S_2O_3H$, which may be termed dinitrosoferrothiosulphuric acid, have recently been discovered by K. A. Hofmann and O. F. Wiede. A current of nitric oxide is passed through a strong solution containing 300 grams of potassium thiosulphate, together with 200 grams of ferrous sulphate. Red-brown leaflets of the composition $Fe(NO)_2S_2O_3K.H_2O$ are precipitated. This substance is stable, for it may be dried in a vacuum desiccator without change. It dissolves but sparingly in water, but forms a greenish-yellow solution in concentrated sulphuric acid without decomposition. Ammonium and sodium salts have also been produced, though with greater difficulty than the potassium compound. It is interesting to note that cobalt may replace the iron in the above compounds, though its compounds cannot be very satisfactorily isolated. The reaction resulting in the production of this complex acid, which contains iron no longer in the basic form, may be viewed as follows.

In the first case it may be supposed that a double thiosulphate of iron and potassium is formed. Postulating that this may have the composition $KO_3S_2.Fe.S_2O_3K$, or



(KS_2O_3) is replaced by two (NO) groups, giving $KO_3S_2.Fe.2NO$. Probably the displaced radical forms potassium tetrathionate in the same way as sodium tetrathionate is produced by the action of iodine on sodium thiosulphate.

$$2NaO.SO_2.SNa + I_2 = 2NaI + NaS_2O_3.O_3S_2Na.$$

A sulphide of carbon corresponding to carbon monoxide has hitherto been wanting. Dr. Deninger has been able to fill up the gap, thus rendering the parallelism between the properties of oxygen and sulphur in certain of their compounds yet more complete and striking. Just as carbon monoxide is a more perfect gas than carbon dioxide, we find that carbon monosulphide is a gas condensing to a colourless liquid when sufficiently cooled, whereas carbon disulphide is a liquid at ordinary temperatures. The new gas was produced by heating an excess of chloroform with dry sodium sulphide to 180° C. in tubes deprived of air.

$$3Na_2S + 2CHCl_3 = H_2S + 6NaCl + 2CS.$$

The mixture of hydrogen sulphide and carbon monosulphide was passed through a solution of sodium hydrate to absorb the former gas. A purer product was obtained by substituting iodoform and silver sulphide in the above reaction. The gas is combustible and

explodes with oxygen. It is readily absorbed by aniline or alcohol. CS may also be produced by the action of metallic sodium on carbon bisulphide in presence of aniline. The latter dissolves off a grey coating which, in its absence, forms on the surface of the sodium and prevents its farther action.

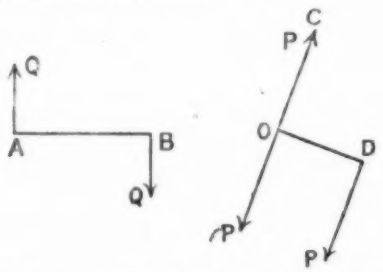
By the distillation of a mixture of PCl_5 and NH_4Cl a series of compounds of the formula $(PNCl_2)_n$ are produced thus—$nPCl_5 + nNH_4Cl = (PNCl_2)_n + 4nHCl$. Two very stable compounds have been isolated, having the formulæ $P_3N_3Cl_6$ and $P_4N_4Cl_8$. They are not decomposed by aqueous acids or alkalies nor by boiling water. By long-continued agitation of the solutions in ether with water, acids are formed of the composition $P_3N_3(OH)_6$ and $P_4N_4(OH)_8.H_2O$ respectively. The former gives two series of salts and is tribasic and hexabasic, the latter similarly yields three series of salts corresponding to dibasic, tetrabasic, and octobasic compounds.

NOTES ON THEORETICAL MECHANICS.

ADVANCED AND HONOURS STAGES.

BY F. CASTLE, M.I.M.E.

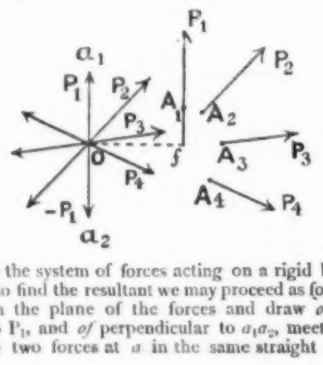
ALTHOUGH the elementary propositions referring to couples are very important, they would require (with one exception) too much space to be considered in these notes; and as all the information required can easily be obtained from any of the text books already mentioned, it is not necessary to do more than draw attention to them here. The exception referred to is the following important proposition: If a single force and a couple act upon a rigid body, they are equivalent to a single force.



Let P, acting at point O in the line OC, be the single force, the couple being QQ; and AB the arm of the couple. Transfer the couple so that its arm passes through O, its position so chosen that one of the forces shall act in the same straight line as the given force P, but in the opposite direction; and its magnitude such that $P \times OD = Q \times AB$. In this manner we obtain three forces, two of which, P and $-P$ in the same straight line, balance; and the third is the force P at D, which is therefore the resultant required.

Hence it follows that a single force acting at a point can be replaced by an equal force acting at any other point and a couple. The force is independent of the position of the point, as it must be equal to the given force; but the length of the arm of the couple, and therefore the magnitude of the couple, does depend on the position of the point.

If any number of forces are acting on a rigid body, the direction of the line of action of the forces not passing through one point, they may be reduced to a force and a couple; hence the importance of the preceding proposition. Thus let



$P_1P_2P_3P_4\ldots$ be the system of forces acting on a rigid body at points $A_1A_2A_3A_4\ldots$; to find the resultant we may proceed as follows:—Take any point o in the plane of the forces and draw oa_1, oa_2 equal and parallel to P_1, and of perpendicular to a_1a_2, meeting P_1A_1 produced in f (the two forces at a in the same straight line and each equal to P_1 will not alter the effect of the system of forces in any manner). The three forces P_1 along oa_1, $-P_1$ along oa_2, and P_1 along P_1A_1 are equivalent to a force P_1 along oa_1 and a couple $P_1 \times of$; or $P_1 \times p_1$ where p_1 is equal to of.

In a similar manner the force P_2 may be replaced by a single force at o and a couple P_2p_2, where p_2 denotes the perpendicular let fall from o to the direction of P_2A_2. In the same manner the forces P_3 at A_3 and P_4 at A_4 are equivalent to forces P_3 and P_4 at o and couples P_3p_3 and P_4p_4. Hence the forces $P_1P_2P_3P_4\ldots$ at $A_1A_2A_3A_4\ldots$ are equivalent to—

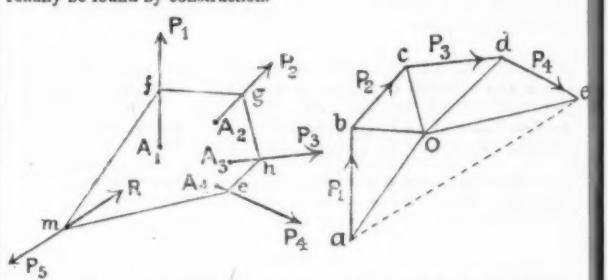
(1) A system of forces equal and parallel to the given forces and acting at the arbitrary point o.

(2) A system of couples in the plane of the forces.

The forces $P_1P_2P_3P_4\ldots$ at $A_1A_2A_3A_4\ldots$ can be compounded into a single force R (either by the parallelogram or polygon of forces), and the system of couples into a resultant couple; denoting the resultant couple by C, then C is the algebraic sum of $P_1p_1 + P_2p_2 + P_3p_3 + P_4p_4\ldots$ The magnitude of C will depend on the position of the point o; but R, the resultant force, will be the same for any position.

The conditions of equilibrium require both the resultant force R and the resultant couple C to be zero.

The resultant of any number of forces $P_1P_2P_3P_4\ldots$ can most readily be found by construction.



Assuming the magnitudes and directions of the four forces $P_1P_2P_3P_4$ known; to find the resultant R. Draw the polygon *abcde* making *ab*, *bc*, *cd*, and *de* parallel and equal to $P_1P_2P_3P_4$ respectively, then the magnitude and direction of the resultant is given by the closing line *ae*, and the equilibrant P_5 by *ea*. To find a point on the line of action of the resultant, assume any point *o* and join *abcd* and *e* to point *o*; next draw the polygon *fghem*, having the sides *fg*, *gh*, *he* parallel to *ob*, *oc*, *od*, *oe* respectively; then if *fm* be drawn parallel to *oa*, and *em* parallel to *oe*, the position of the resultant is determined, its magnitude and direction being already known. The point *o* is called the *pole*, and the polygon *fghem* the *funicular polygon of the forces* $P_1P_2P_3P_4$ *with respect to the pole o*. It must be carefully noted that the conditions of equilibrium for any system of forces acting on a rigid body are—

(1) The polygon of forces *abcde* must close.

(2) The funicular polygon with respect to any pole *o* must also close.

The second condition clearly implies that the algebraic sum of $P_1p_1 + P_2p_2 + P_3p_3 + P_4p_4$ is zero, where $p_1p_2\ldots$ are the perpendiculars let fall from any point on to the lines of action of the given forces.

(To be continued.)

HONOURS PHYSIOGRAPHY NOTES.

BY A. M. DAVIES, B.SC. (LOND.), F.G.S.,

Late Demonstrator in Geology at the Royal College of Science.

THE ORIGIN OF OOLITIC STRUCTURE.

THE rounded oolitic grains which are best known as building up a great part of the jurassic limestones of England are of very widespread occurrence. They are known from rocks as low as the Cambrian, and in many of the later formations, while exactly similar grains are being formed under various conditions at the present day. The best known of these last are the grains from the Bahamas, long ago described by De la Beche; others are found in the Great Salt Lake, Utah; while the 'Sprudelstein' of the hot springs of Carlsbad answers in coarseness (the grains being about the size of marbles) to the 'pisolites' or 'pea-grits' of certain geological formations.

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Twenty years ago the minute structure of these grains was studied by Sorby. He showed that they usually have a small central 'nucleus,' often a fragment of shell, etc., around which the carbonate of lime is deposited in a concentric manner, slight differences in colour marking out successive zones. (See fig. 30, p. 152, *Hons. Physiog.*) Sometimes there is, in addition, a marked radial structure like that seen in the spherulites of igneous rocks. Until recently it was generally supposed that these grains were formed by a purely chemical action—deposition from a saturated solution. Thus, in the case of the Bahamas, the granules are formed in shallow sea-lagoons where the water is subject to considerable evaporation, and it was supposed that as evaporation went on the excess of calcium carbonate was deposited around any particles lying at the bottom. These particles formed the nuclei, and being continually rolled about, received an even coating of calcium carbonate on all parts, so that gradually a regular concentric structure was produced. The radial structure was regarded as a secondary one, due to mineral change after formation. It is probable that the Bahamas granules are strictly comparable to the majority of known geological ones, as they appear to be formed under very similar conditions, namely, the conditions that are also favourable to the growth of coral reefs, in association with which they are found.

More recently, however, an organic origin has been claimed for oolitic grains in general. Messrs. Nicholson and Etheridge found in certain Ordovician oolites of the South of Scotland a peculiar tubular structure which they suggested might be a Foraminifer, and to which they gave the name *Girvanella*. Subsequently Mr. Wethered and others have discovered similar structures in oolites of all ages, including those of modern formation. In several of these last, it has been conclusively shown that, on dissolving away the calcium carbonate, organic structures remain which are clearly of the nature of algæ. It is now therefore generally considered that *Girvanella* is also an alga; but several alternative explanations of its relation to the oolitic granule are suggested:—(1) That *Girvanella* is a true calcareous alga (*i.e.*, that it secretes Ca CO_3 in its cell-wall), and that the oolitic granule is actually built up by the twining of a *Girvanella* filament round the central nucleus; (2) That it is not a truly calcareous alga, but that its absorption of CO_2 from the sea-water (in the physiological process of carbon-assimilation) causes the precipitation of the Ca CO_3 held in solution by the excess of CO_2—the precipitation encrusting the alga and the nucleus round which it twines; (3) That the granules are formed inorganically, and that the *Girvanella* is a *boring* alga. The third of these is founded on the well-established cases of algæ which bore their way into and through calcareous shells, absorbing Ca CO_3 instead of secreting it. It is objected to on the ground that the tubules have a definite calcareous wall, which would not be the case in a boring alga. Probably both constructive and destructive algæ may be present in some granules, as suggested by Professor Judd.

The general tendency at present is to accept the first of these three explanations, as applying to the majority of cases. It does not seem, however, that the *Girvanella* tubules actually make up the total bulk of the rock; there is much interstitial calcareous matter that may have been chemically precipitated during or after the formation of the granules. It is also probable that the delicate tubular structure may have once existed, and since have been obliterated by mineral changes in granules that now show no trace of it. With regard to the radial structure it has usually been considered as secondary and due to mineral change, but Mr. Wethered in his latest paper (*Quart. Journ. Geol. Soc.*, May 1895) states that the true radial structure is due to tubules growing at right angles to the nucleus. Several other observers seem inclined to dispute this, and, while admitting the organic origin of the granules as a whole, to refer radial structure to secondary mineral change.

Other Rock-forming Marine Plants.

Much has been discovered in recent years that tends to show that simple vegetable organisms play an enormous part in rock-formation. It has been shown that minute plants cause the deposition of siliceous sinter and calcareous tufa around hot and other springs. Most of these are described as algæ of the simplest kind, but some of them are more probably bacteria.

On a larger scale, there are the higher forms of calcareous algæ, belonging to the classes *Floridæ* and *Siphoniæ Verticillatæ*. Of these the common 'coralline' of our coasts is the most familiar modern example. Forms like this are now forming limestone masses, and have been studied by Walther in the Bay of Naples and elsewhere. The most interesting discovery in connection with the modern ones consists in the readiness with which their organic structure may become obliterated—a fact of great significance to the geologist. Limestones composed of the remains of algæ of these classes have long been known in the Vienna Tertiaries (*Lithothamnion*-limestone) and have recently been described from Japan. Among the Alpine Triassic dolomites, too, similar forms are abundant; and it is quite possible in view of the statement above as to obliteration of structure, that many of the massive structureless limestones of that age may be of algal origin.

It appears possible that the manganese nodules of the deep sea may have an organic origin, like that of the oolitic granules. So many of what were once thought to be merely chemical precipitates have thus been shown to be due to organic agency, that Prof. Judd has even asserted that matter in solution in sea-water is never removed from it except by the agency of living organisms.

Pseudomorphism of Oolitic Rocks.

Rocks with oolitic granules seem very liable to pseudomorphous alteration—possibly not more so than other limestones, only the oolitic structure can readily be recognised in the altered rock. Among the commonest replacing substances is carbonate of iron—many of the English iron-ores being pseudomorphosed oolites. Replacement by silica is less common, but many cases are known. A peculiar case was described long ago by Prof. Judd in the oolites of Rutland, where it was found that on dissolving away the calcium carbonate by acid, a series of thin concentric shells remained, composed of silica: these retained the form of the oolitic grains, but on breaking one open, another smaller one was found loose inside, and so on.

The Origin of Coal.

Mr. A. C. Seward has lately summarized (in *Science Progress*) modern discoveries and theories on the origin of coal. The tendency appears to be towards the abandonment of the view, generally held in England, that a coal-seam represents the actual plant-growth *in situ*, and the adoption of the view that coal is, in general, a deposit of drifted vegetable material, and quite as much a sedimentary rock as the clays and sandstones with which it is interstratified. This is in accordance with the views of Jukes, who 25 years ago pointed out the difficulty of applying the theory of growth-in-place and irregular subsidence to cases such as occur in South Staffordshire, where thick coal seams, when traced along horizontally for a few miles, are found to split up into a number of small seams separated by sandstones and shales. Such cases are easily explainable if we consider the plant-remains that make up the coal to have been carried by water to their place of deposition: the single thick coal-seam will then mark a place of continuous deposition of vegetable matter, and the numerous thin ones indicate periodic extensions of the area of deposition. Whether such localities may have been situated in the delta of a large river, or in land-locked lagoons, is uncertain. Rivers in southern India flowing through a forest-country are known to carry out large quantities of vegetable matter that form a fairly pure carbonaceous deposit, comparable to coal. Some coal has, probably, been formed of the remains of plants that have grown in the position where their remains are now found, but the general tendency now is to regard most coals as formed of drifted material.

The Cause of Faults.

Mr. J. A. Church has recently discussed this question. He calls attention to a point that is usually much neglected, *i.e.*, the *length* of faults, or the linear distance along which a displacement of beds is recognizable. Dealing particularly with 'short' faults, less than 2,000 feet long (the ones of most technical importance in mining), he considers that in these the production of the fissure takes place at an earlier date than the displacement of the two sides. The latter is caused, in his opinion, by an end-to-end compression, which bends the beds differently on the two sides of the fissure-plane: often an anticlinal is formed on one side and a synclinal on the other, or more complicated and irregular folds may be produced. A good example of such a case has been described by Messrs. Lake & Groom, in the Corwen district, where a steep-sided valley runs along a line of fault, so that the dissimilar curves of the rocks on the two sides can be easily traced on the sides of the valley. The peculiarity here is that by the intersection of these curves, the up-throw and down-throw sides are twice reversed. (*Quart. Jour. Geol. Soc.*, 1893.)

That even in the case of short faults, matters are often more complicated will be seen by noticing on a geological map the general association of faults in groups, forming a T, Y, or more complicated groups. It seems hardly necessary, either, to assume that the fissure must have been in existence in order that the two sides should have a plane of dislocation ready determined when compression took place. Local folding is generally irregular, and whether the irregularities take the form of minor folds oblique to the main ones, or of actual faults, must depend on the resistance of the rocks to the stress at each particular point.

The case of long faults, like the great Highland one that cuts right across Scotland, from sea to sea, does not come under the preceding considerations. Such faults are usually formed along the axis of intense folding.

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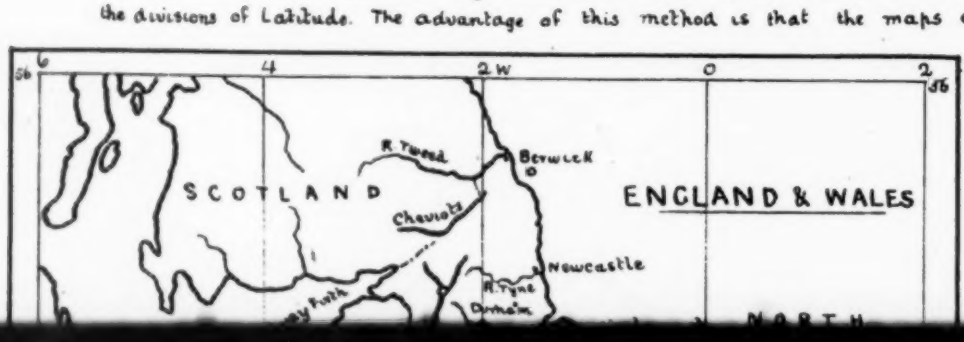

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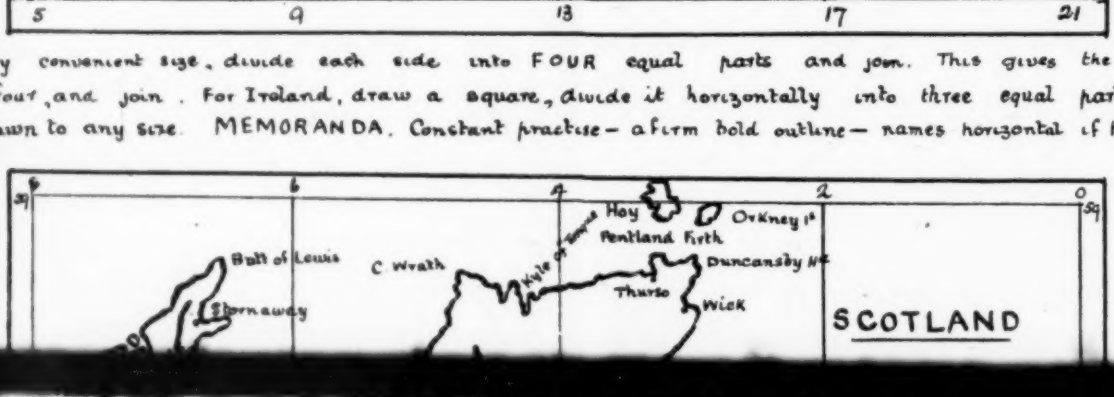

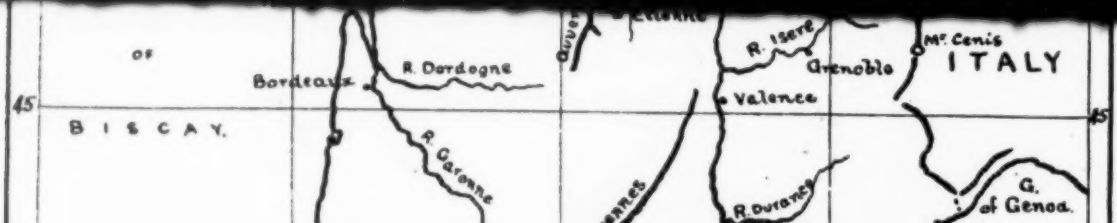

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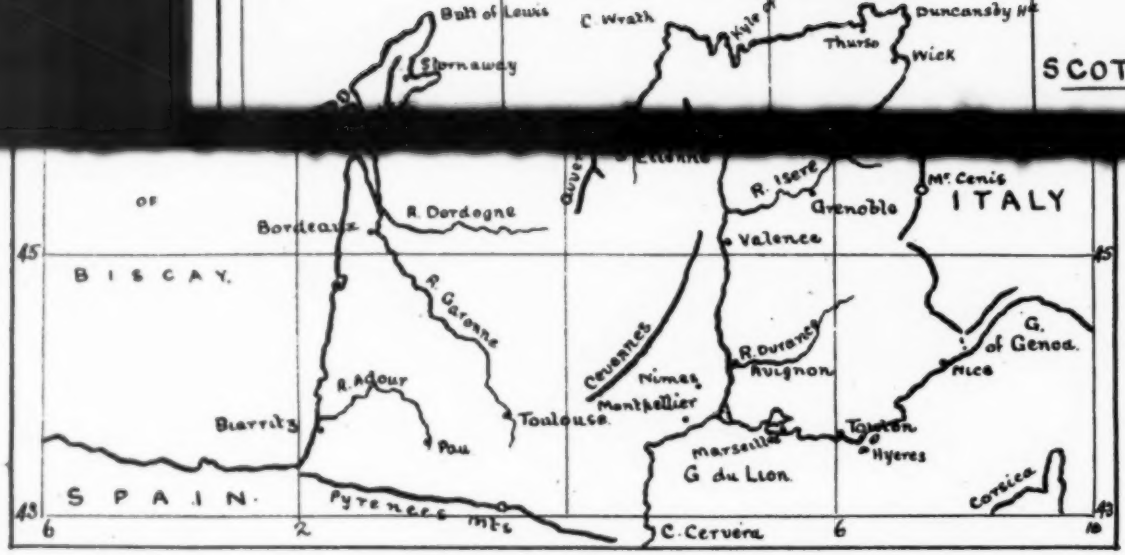

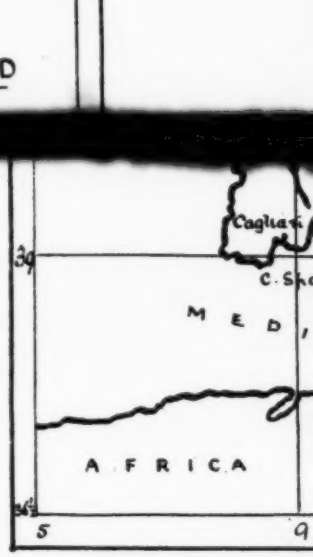

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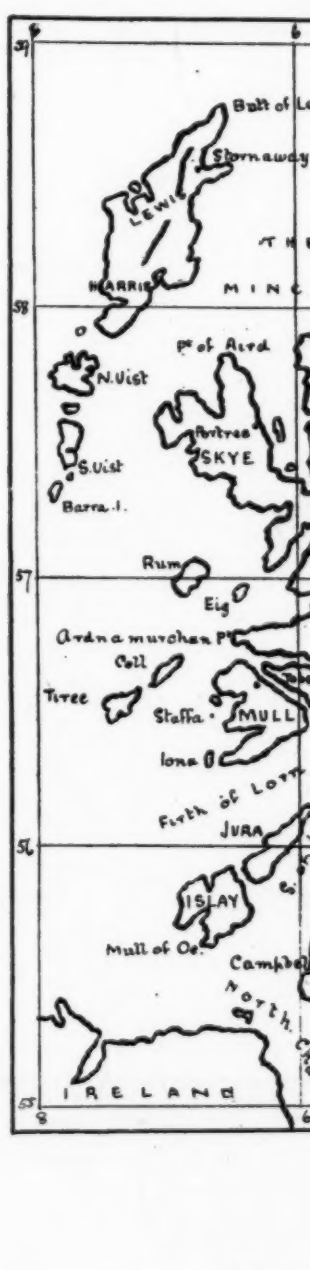

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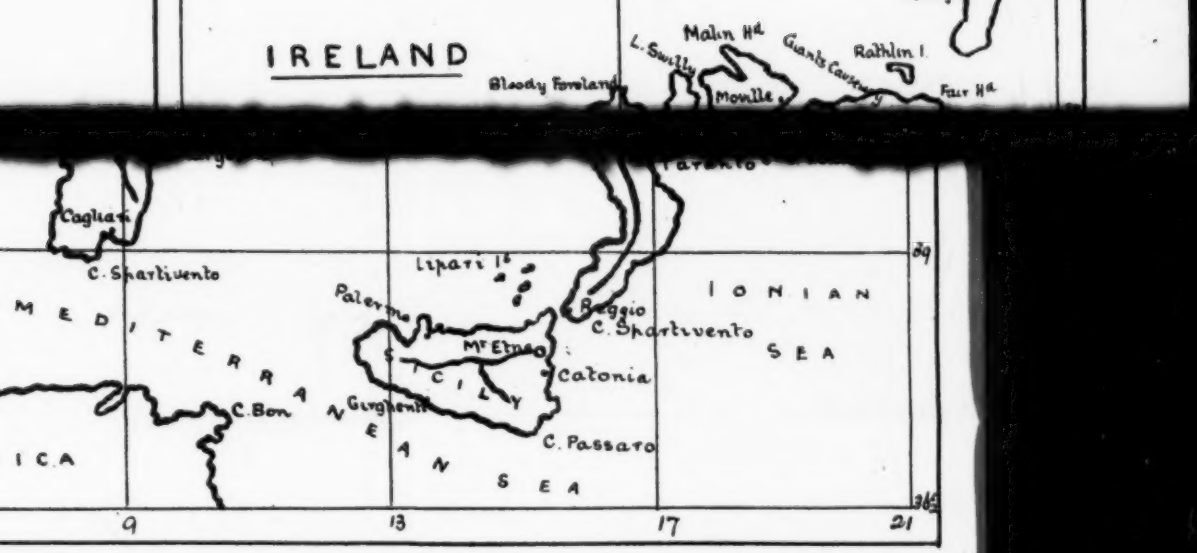

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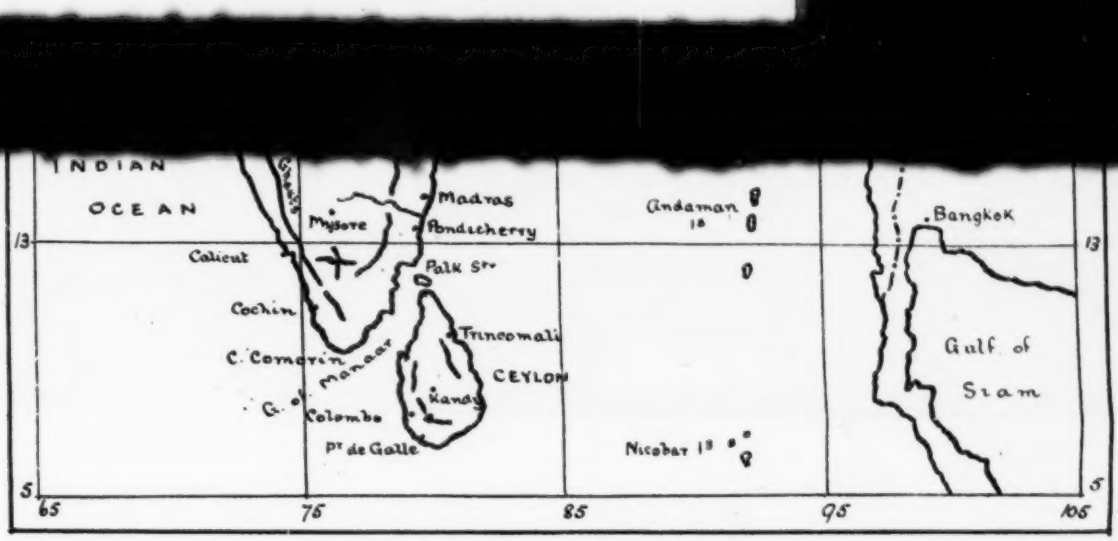

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